Aviation Safety Program

Report to Industry

8/13/97

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Outline

- **Background**
- **The Aviation Safety Program**
- **How to get involved**
- **Program philosophy**

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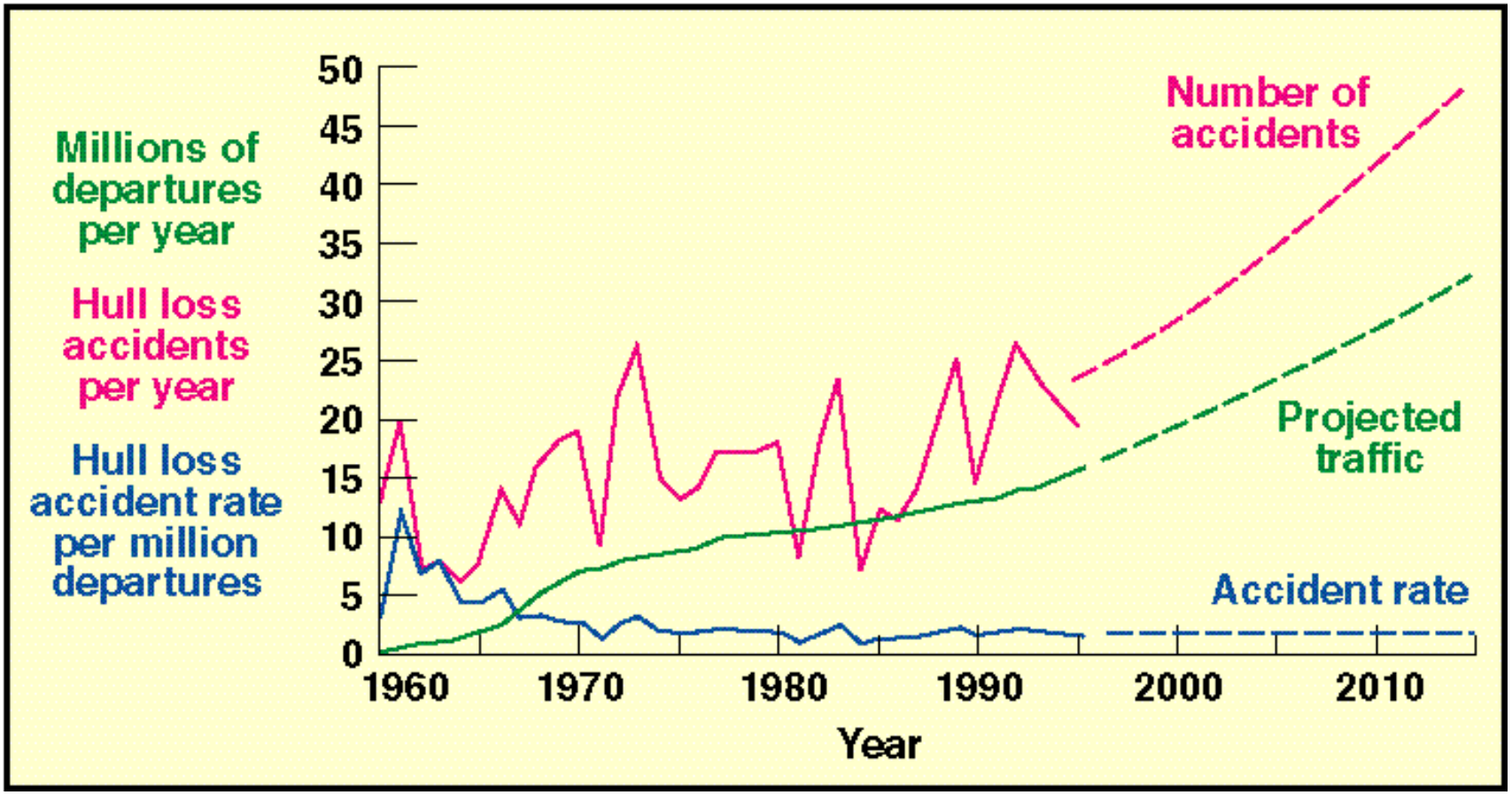
Safety Challenge:

Number of accidents will significantly increase if accident rate does not decline



Background

- **Historically, major advances in safety have been driven by technological revolutions**
  - **Airframe structures (materials, analytical methods)**
  - **Turbojet engines**
  - **Radio/Radar**
  - **Simulators**

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Background

- **The next technology revolution is already underway -- Information Technology (IT)-- and it will significantly impact safety, security, and air traffic control modernization**
  - **Aviation is Transitioning to Digital Systems**
  - **Each Part of the Aviation System is Imbedding IT**
  - **Drivers - Economics & Global Competition**
  - **An Interconnected Aviation System of Systems is Evolving**

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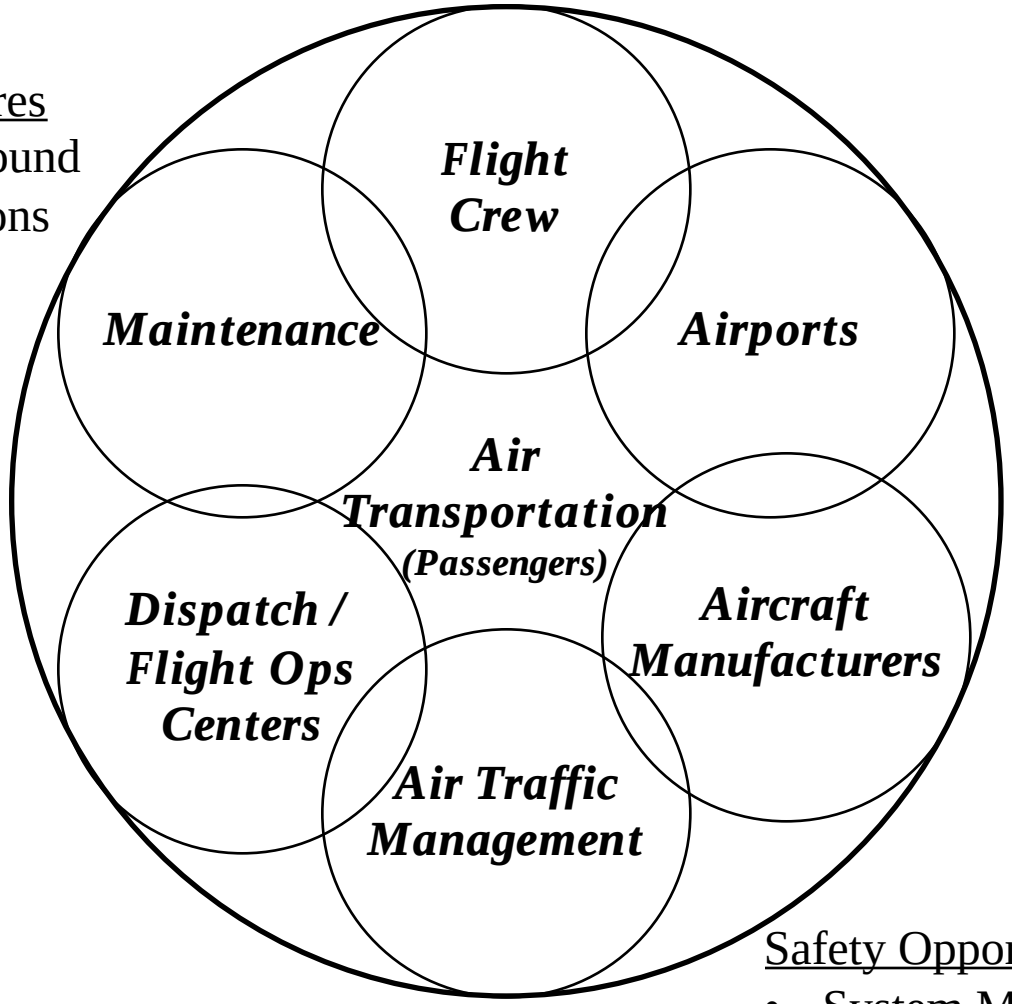
Integrated Aviation Information System
Aeronet

Six Aviation Cultures
- Common Background
- Laws & Regulations
- FAA Oversight
- Industry Assoc.
- Industry Forums



Drivers for Change
- -Information Technology
- -Economics
- -Globalization

Change
- Communications
- Decision Making
- Roles of People
- Pace of Change

Safety Opportunity
- System Monitoring
  - Aircraft/System Operations
  - Operating Procedure Effectiveness
  - System Reliability
  - Accident / Incident Investigation

Aviation Safety Research has Always Been Part of NASA's Mission

Recent Accomplishments:

- Airborne Wind Shear Sensors Technology Provides Advance Warning
- Stall/Spin Improvements Slash General Aviation Accident Rate
- Propulsion Control Aircraft System Provides Emergency Maneuverability
- Human Factors Training in Cockpit Resource Management Saves Hundreds of Lives
- Human Fatigue Countermeasuers Improve Operational Safety
- Research Provides Protection from Lightning and Stray Electromagnetic Radiation

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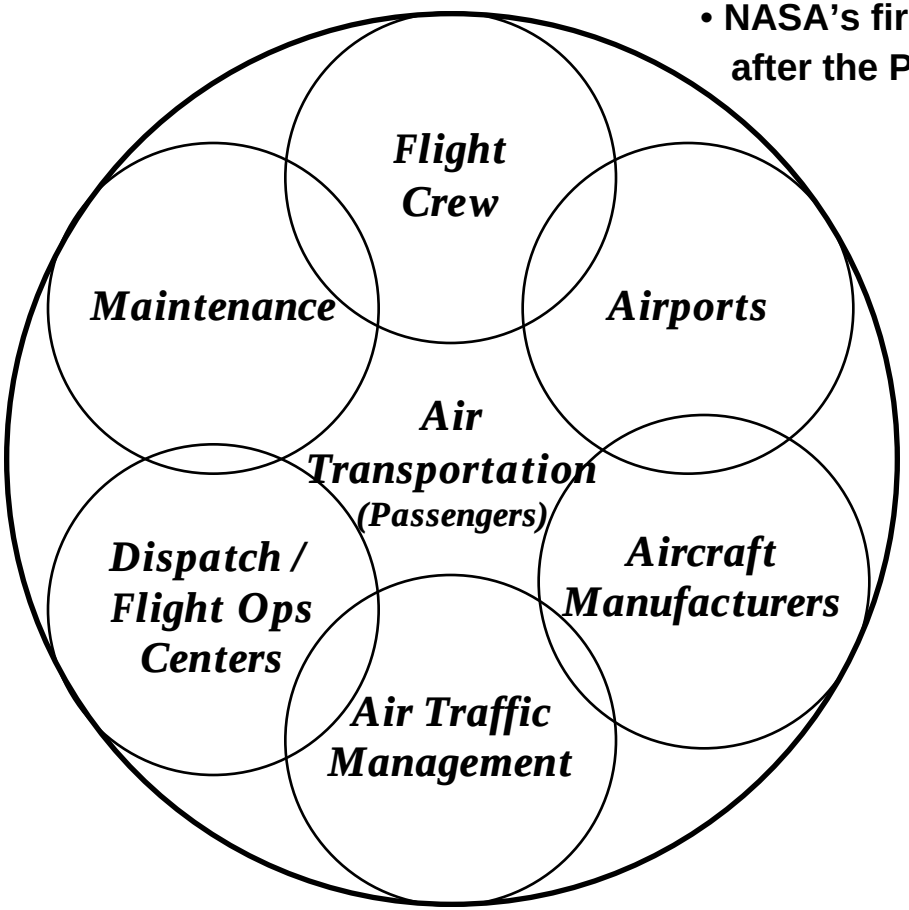
NASA Comprehensive Aviation Safety Initiative: Two Years in the Making

- Aviation Safety identified as needing more attention (1995)
- FAA Safety Executive detailed to NASA (1995)
- Joint NASA/FAA Aviation Safety Baseline developed (1996)
- Baseline results coordinated with the Aviation Community (1996-7)
- NASA decision to invest $500M as a result of the Gore Commission
- NASA's first Aviation Safety Strategy Workshop occurred 6 days after the President announced the National Aviation Safety Goal.

Aeronet



Aviation Safety Goals

AIRCRAFT / ATC SYSTEM(S): *Prevent Malfunctions*

PEOPLE: *Eliminate Human Caused Mishaps*

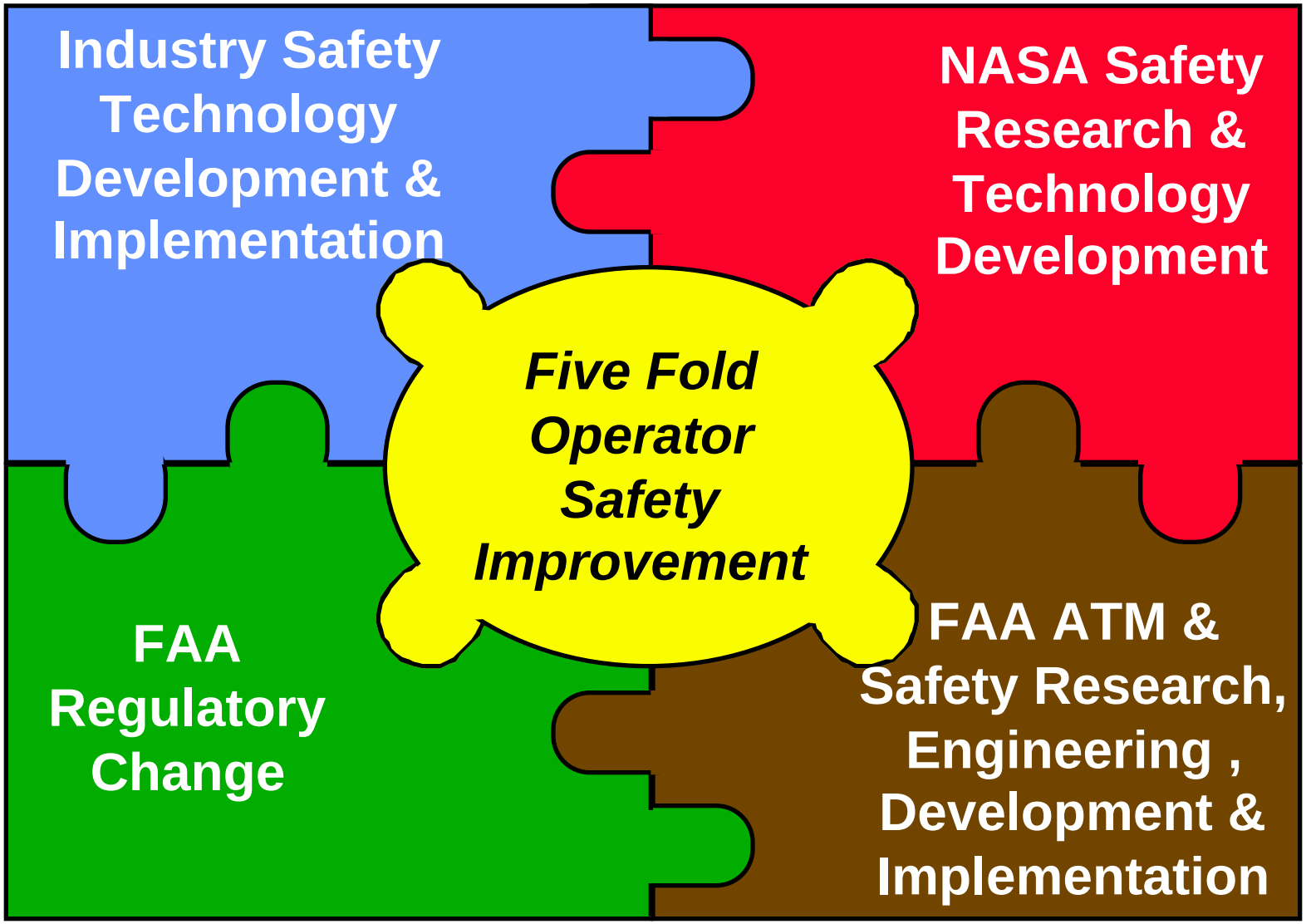
ENVIRONMENT- *Ensure Separation Between Aircraft and Hazards*

Aviation Safety Research

“We will achieve a national goal of reducing the fatal aircraft accident rate by 80% within 10 years.”

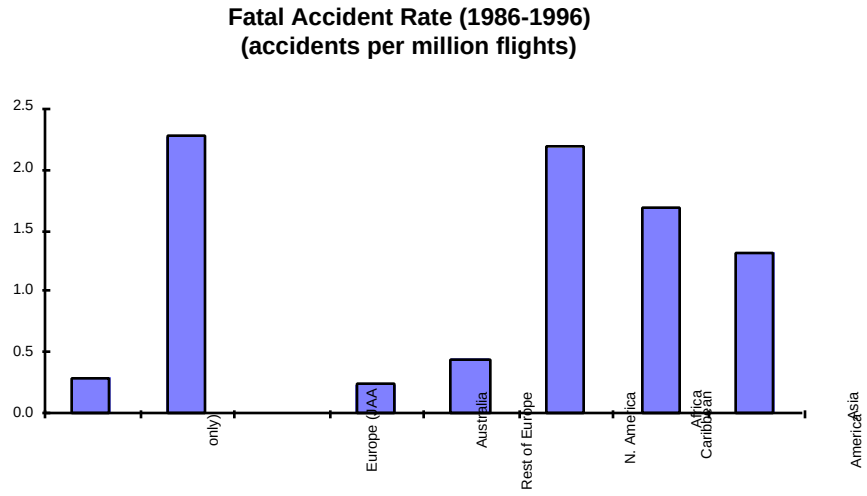
President William J. Clinton, February 12, 1997

National Aviation Safety Goal



Aviation Safety is a Global Issue

- **Aircraft / Equipment Sold Internationally**
- **Passengers Travel Internationally**
- **Carriers Operate Internationally**



- **US Aviation Safety Initiative being formed.**
- **It is vital that you join with us to achieve "Five-fold reduction..." as an International Goal.**
  - Do you want to join with us?
  - What are your current/planned Safety Research efforts?
  - How should we proceed?

Forces Converging to Enable the Goal

- **Information Technology Revolution**
- **Top Level Support**
  - **Government - President, Congress & Agency Administrators**
  - **Industry - CEOs**
  - **Public & Press - Intense interest**
- **NASA initial investment of one-half billion dollars**
- **Transition to New Air Traffic Management System**
- **Retrofit of Aviation Fleet to Digital Com, Nav, & Surveillance (CNS) Technologies**

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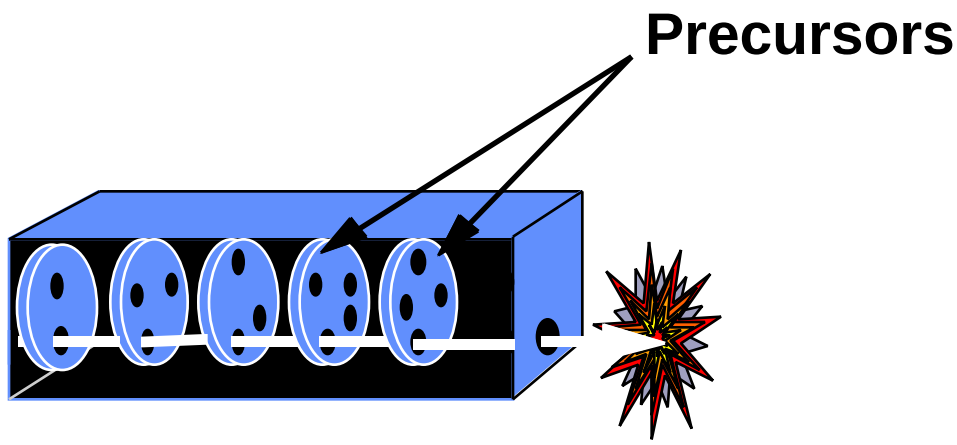
NASA's Role in Aviation Safety:

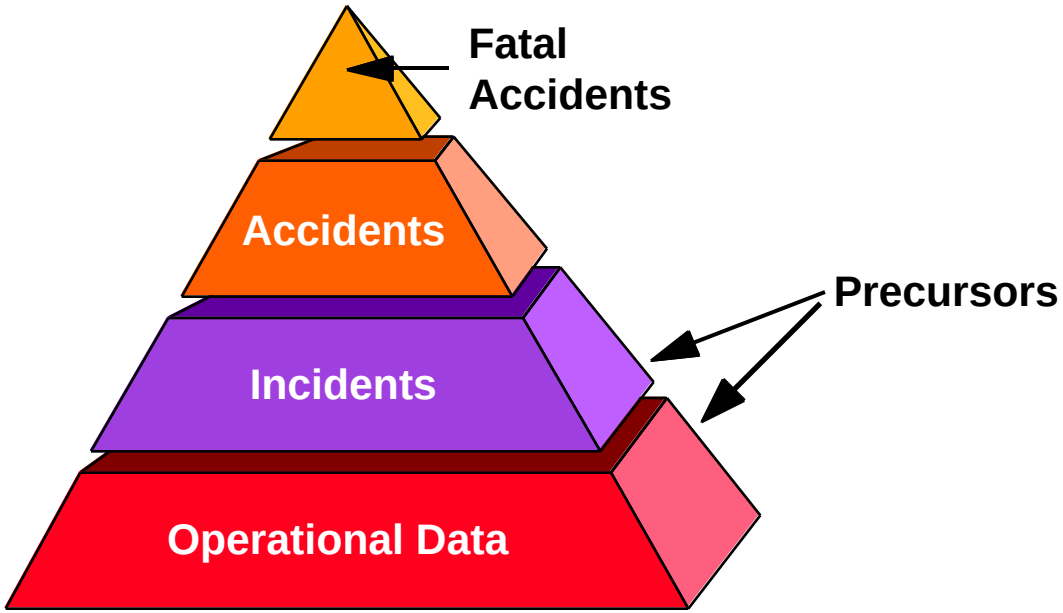
To Develop the Enabling Technology to Eliminate Accident Precursors



Alignment = Incident or Accident

Metrics

- The ultimate metric is fatal accidents
- Fatal accidents are difficult to use as a metric for measuring research progress
  - Few fatal accidents occur per year
  - The circumstances of fatal accidents vary greatly
- The challenge is to accurately identify accident precursors from the much larger set of incidents or from operational data such as flight data recorders
- The understanding between accidents and accident precursors does not exist today



NASA Aviation Safety Research Initiative:

A Partnership for Safety

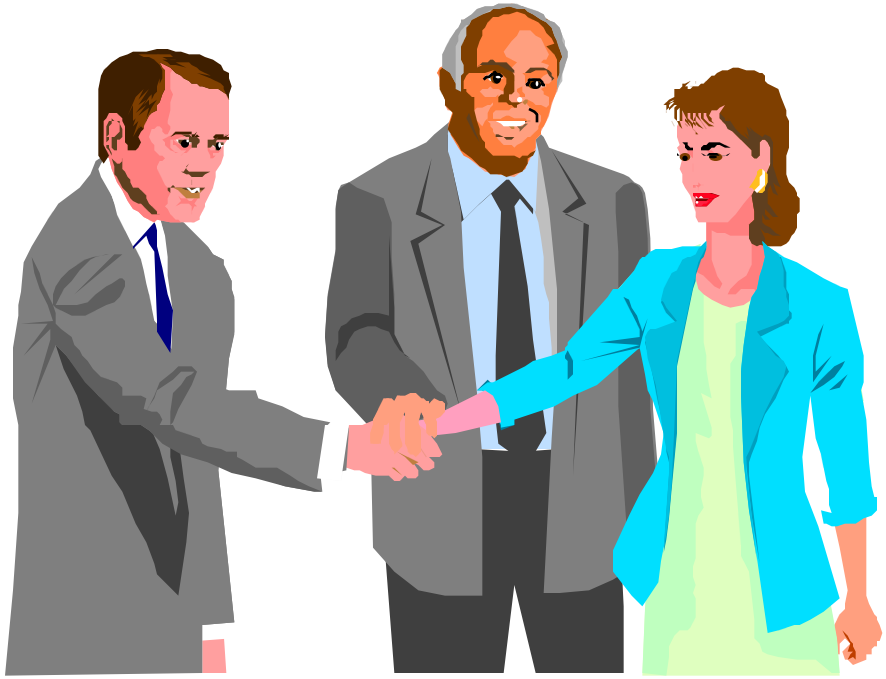
NASA
- Program Development
- Enabling Technology

FAA
- Regulation / Certification Issues
- Technology Insertion

DoD
- Technology Transfer (military -> civil)

Industry
- Issue Identification
- Feedback
- Implementation

Universities
- Research



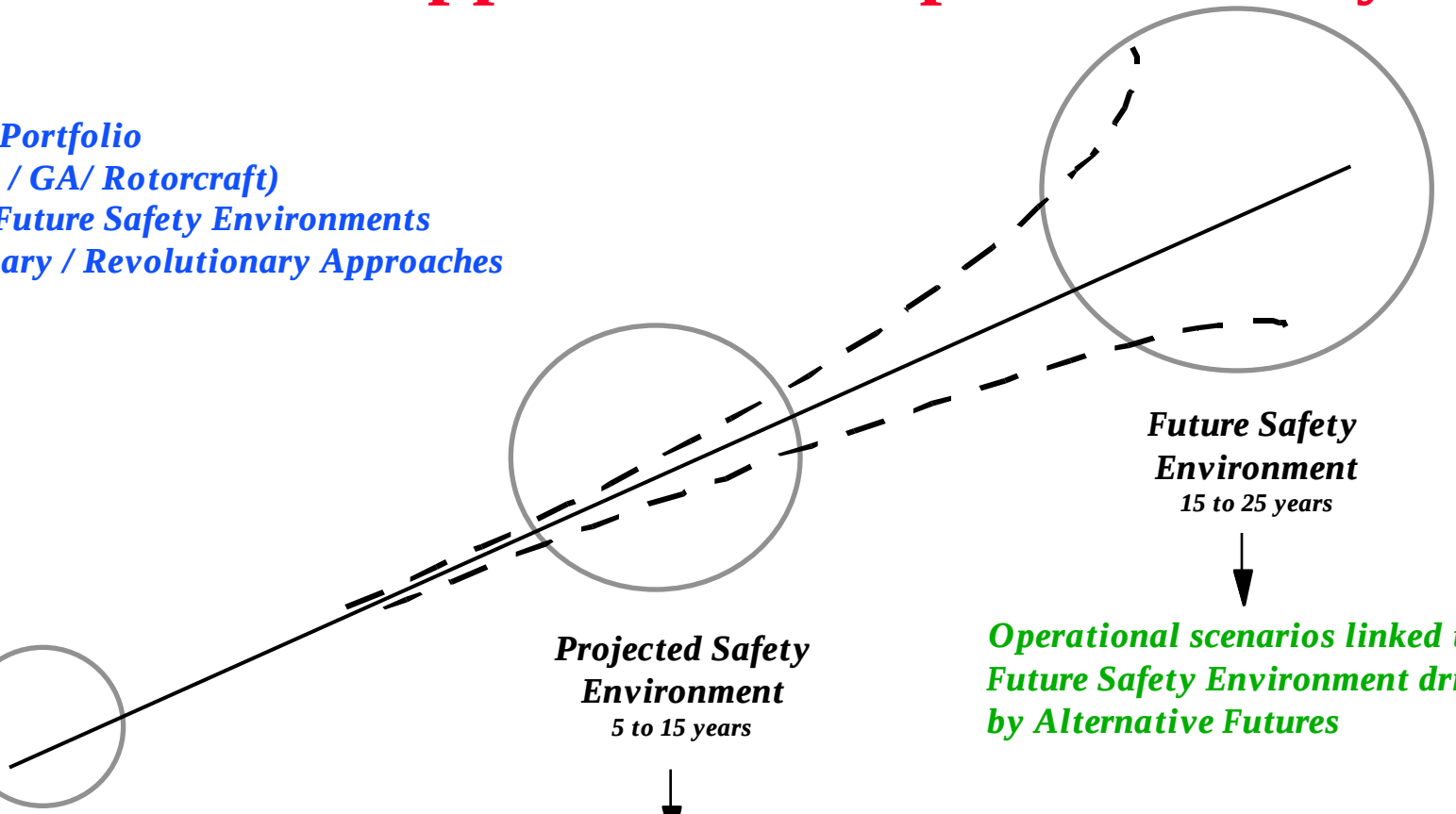
Coordinated Program Planning

ASIST Participating Organizations

Advanced Nav. & Position Corp.
AIA
AIAA
Alaska Airlines
Allied Signal
Allison Engine Company
ALPA
AMA
AOPA Air Safety Foundation
ARCCA
ARINC
Arizona State Univ.
ARNAV Systems, Inc.
Assoc. of Flight Attendants
ATA
Aviation Research Inc.
AvioniCom
Battelle
Bell Helicopter/ Textron
Boeing
Boeing Helicopter Group
Boston University
Cessna Aircraft Co.
Delta Airlines
DoD/ Air Force Safety Center
DoD/ ARMY Safety Center
DoD/ NAV Air
DoD/ Naval Safety Center
DoD/ NAVMAR
DoD/ NAWCAD, Pax River
DoD/ USAF, 416FLTS
DoD/ USAF/WPAFB
DoD/ WL/XPK
DOT/ Volpe Center
Embry-Riddle Aeronautical Univ.
ERC Inc.
FAA/ AAR
FAA/ AAR (LaRC)
FAA/ ACE
FAA/ AFS
FAA/ AIR
FAA/ AND
FAA/ ANM
FAA/ ARA
FAA/ ASD
FAA/ ASY
FAA/ AUA
FAA/ AVR
FAA/ AWR
FAA/ CAMI
FAA/ Technical Center
Flight Data Co.
GAMA
General Electric
Gulfstream Aerospace
Helicopter Assoc. Inter. (HAI)
Honeywell
Hughes
Jeppesen
Johns Hopkins Univ.
Litton/ APD
Litton/ PRC
Lockheed Martin
McDonnell Douglas
McDonnell Douglas Helicopter
MITRE Corporation
NARI
NASA/ ARC
NASA/ DRFC
NASA/ HQ
NASA/ JPL
NASA/ LaRC
NASA/ LeRC
NATA
NATCA
Natl. Inst. for Aviation Research
National Weather Service
NAVAIR
NBAA
NCAR
NOAA
North Carolina A&T Univ.
Northrop Grumman
Northwest Airlines
NRL
NTSB - Seattle Field Office
NTSB - Washington, DC Office
OFCM - Fed. Coor. for Metrlgy
Pratt & Whitney Aircraft Engines
Regional Airline Assoc.
Rockwell International
RTI
SAIC
SAMA
Sikorsky Aircraft
TASC
TechMatics, Inc.
Teledyne Cont.
UCLA
University of Illinois
Wichita State University
Williams International

Multi-Level Approach to Improved Safety

- *Balanced Portfolio (Transport / GA/ Rotorcraft)*
- *Current / Future Safety Environments*
- *Evolutionary / Revolutionary Approaches to 5x / 10x*



Current Safety Environment
0 to 5 years

Accident-Driven Issues & Solutions

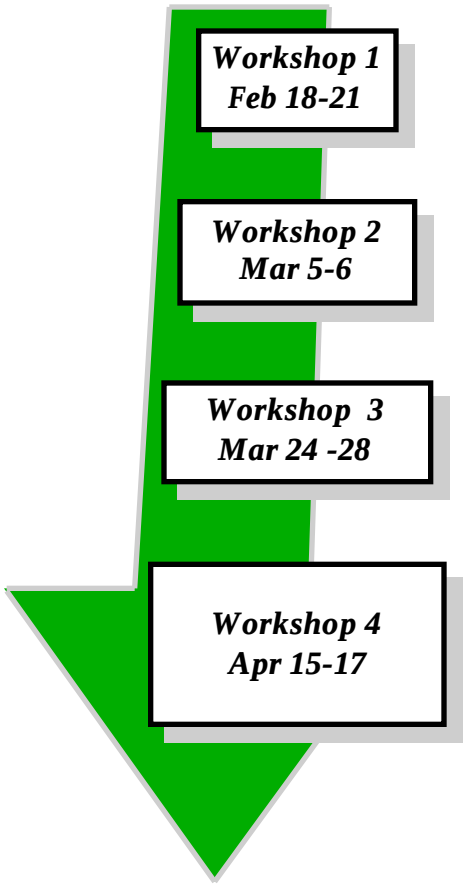
Projected Safety Environment
5 to 15 years

Historical & Future-Based

Future Safety Environment
15 to 25 years

Operational scenarios linked to Future Safety Environment driven by Alternative Futures

NASA Aviation Safety Investment Strategy Team (ASIST) Process



Industry Input; Identify Major Accident Causes & Issues

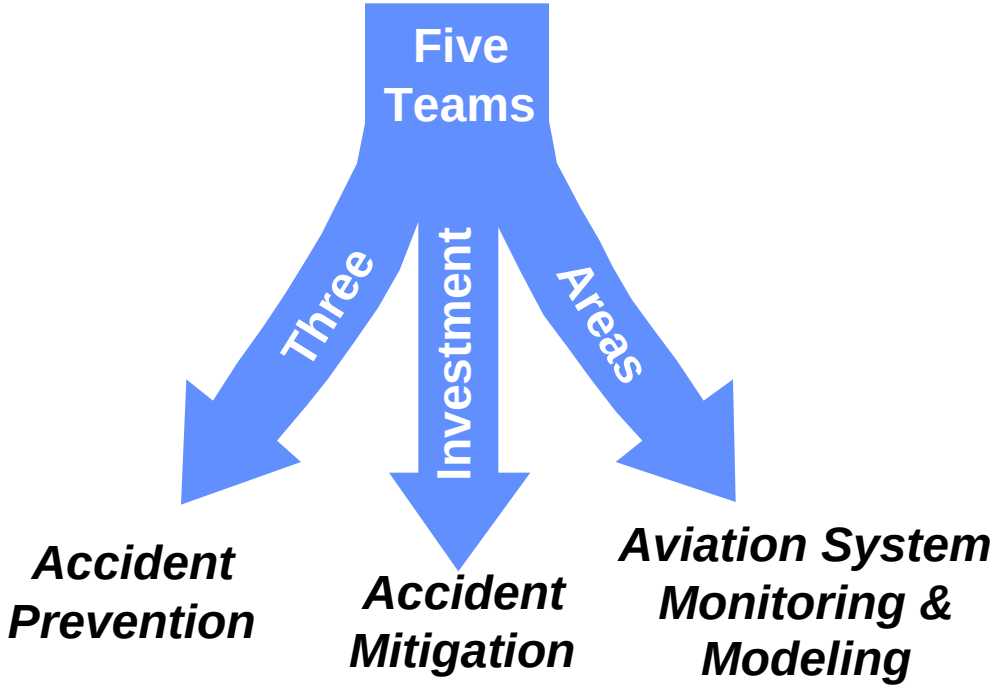
Underlying Problems

Solutions

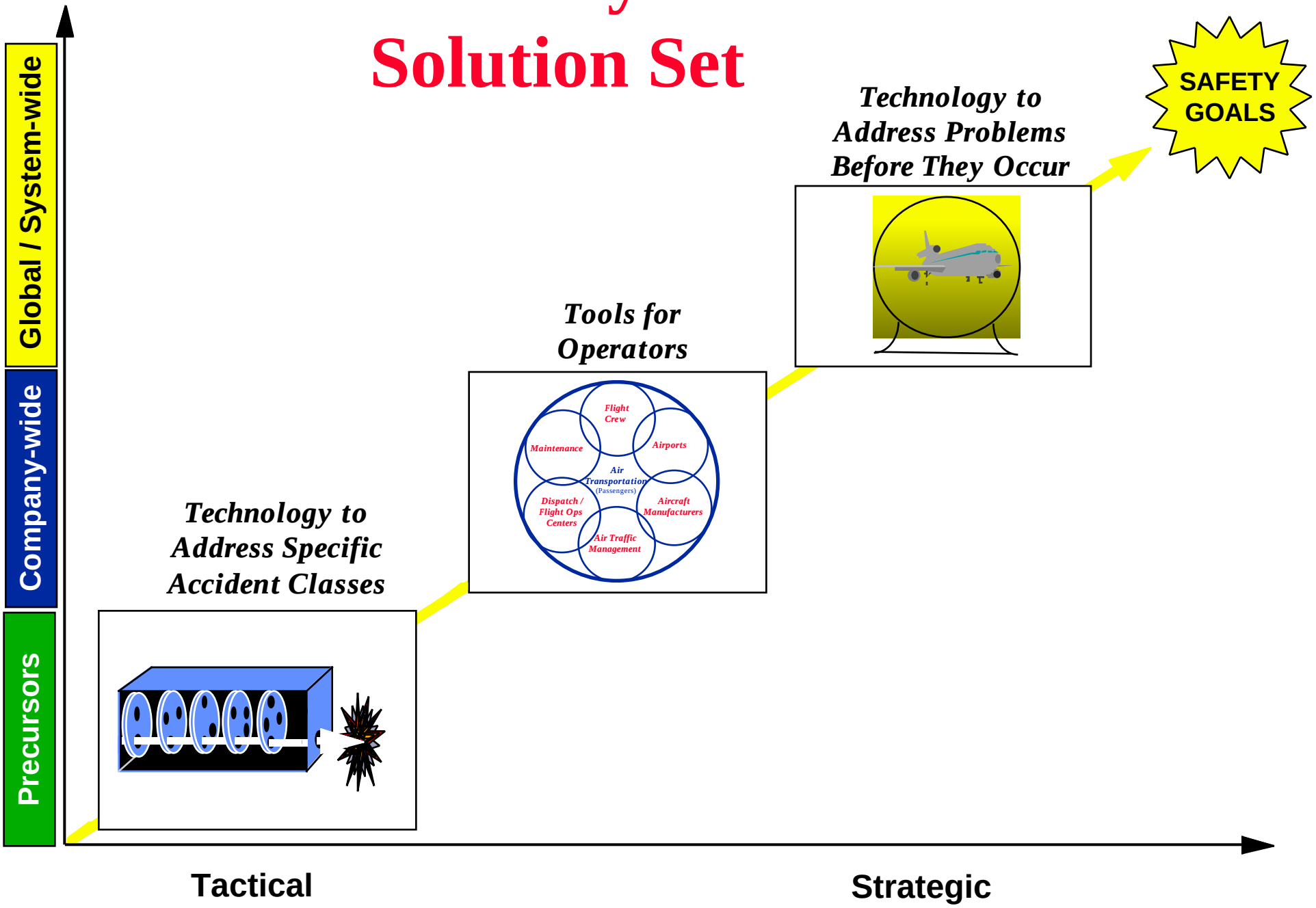
Integrated Solution Set & Investment Options

Five ASIST Sub-Teams Formed:

- Human Error Consequences
- Weather
- Flight Critical Systems & Information Integrity
- Human Survivability
- Aviation System-wide Monitoring, Modeling & Simulation



Aviation Safety Research Solution Set



Outline

- Background
- **The Aviation Safety Program**
- **How to get involved**
- **Program philosophy**

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Accident Data-Driven Approach

(Weather)

Accident Rate Data (approx)								
G/A		Commuter		Transport		Rotorcraft		
Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal	***Atmospheric / Weather Hazard***
1	1	1	1	1	2	1	1	**Ceiling & Visibility**
								Fog/Haze
								Precipitation
								Clouds
								Night Ops
3	2	2	2	2	3	2	2	**Convection and Winds**
								Thunderstorms
								Hail
								Heavy Rain
2	1	2	2				1	Winds
		2		2				Wind Shear
3	3	3	3	3	1	3	3	**Turbulence**
								Convection
								Terrain Induced
								Jet Stream
								Tropopause
								Gravity Waves
								Frontal
2	3	1	2	1	3	2	2	**Icing**
								In-Flight
								Ground
								Induction (Dew Point)
3	3	3	3	3	3	3	3	**Wake Vortex**
3	3	3	3	3	2*	3	3	**Volcanic Ash**
3	3	3	3	2	3	3	3	**Runway Contam.**

1	Significant Contributer to Accidents
2	Moderate Contributer to Accidents
3	Minimal Contributer to Accidents

Solution Strategy Matrix
(Weather)

Accident Rate Data (approx)									Strategic Weather Information					Tactical Weather Information and Aircraft Systems		Weather Operations		
G/A		Commuter		Transport		Rotorcraft		*Atmospheric/ Weather Hazard*										
Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal		Sensing	Collection	Modeling and Forecasting	Product Generation	Data Dissem-ination	Sensors/ Systems	Weather Tolerant Aircraft Design	Simulation and Hazard Character-ization	Crew/Dispatch /ATC Hazard Monitoring, Display, and Decision Support	Crew/ Dispatch/ ATC Training
1	1	1	1	1	2	1	1	**Ceiling & Visibility**										
								Fog/Haze										
								Precipitation										
								Clouds										
								Night Ops										
3	2	2	2	2	3	2	2	**Convection and Winds**										
								Thunderstorms										
								Hail										
								Heavy Rain										
2	1	2	2				1	Winds										
		2		2				Wind Shear										
3	3	3	3	3	1	3	3	**Turbulence**										
								Convection										
								Terrain Induced										
								Jet Stream										
								Tropopause										
								Gravity Waves										
								Frontal										
2	3	1	2	1	3	2	2	**Icing**										
								In-Flight										
								Ground										
								Induction (Dew Point)										
3	3	3	3	3	3	3	3	**Wake Vortex**										
3	3	3	3	3	2*	3	3	**Volcanic Ash**										
3	3	3	3	2	3	3	3	**Runway Contam.**										

1 Significant Contributer to Accidents
2 Moderate Contributer to Accidents
3 Minimal Contributer to Accidents

Current Technology Assessment Matrix
(Weather)

Accident Rate Data (approx)									Strategic Weather Information					Tactical Weather Information and Aircraft Systems		Weather Operations		
G/A		Commuter		Transport		Rotorcraft		*Current Wx Technology/ Systems Assessment*	Sensing	Collection	Modeling and Forecasting	Product Generation	Data Dissem-ination	Sensors/ Systems	Weather Tolerant Aircraft Design	Simulation and Hazard Character-ization	Crew/Dispatch /ATC Hazard Monitoring, Display, and Decision Support	Crew/Dispatch /ATC Training
Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal											
1	1	1	1	1	2	1	1	**Ceiling & Visibility**										
								Fog/Haze	2	2	1	2	1	2		3	1	2
								Precipitation	3	2	1	2	1	3		3	1	2
								Clouds	2	2	1	2	1	2		3	1	2
								Night Ops	3	3	3	3	3	2		3	3	2
3	2	2	2	2	3	2	2	**Convection and Winds**										
								Thunderstorms	2	2	2	2	1	3	2	3	1	2
								Hail	2	3	1	1	1	2	2	3	1	2
								Heavy Rain	3	2	2	2	1	2	2	3	1	2
2	1	2	2				1	Winds	2	2	2	2	1	1	2	3	1	2
		2		2				Wind Shear	2	2	1	3	2	2	2	3	2	2
3	3	3	3	3	1	3	3	**Turbulence**										
								Convection	1	1	1	2	1	1	2	1	1	2
								Terrain Induced	1	1	1	1	1	1	2	1	1	2
								Jet Stream	1	1	1	1	1	1	2	1	1	2
								Tropopause	1	1	1	1	1	1	2	1	1	2
								Gravity Waves	1	1	1	1	1	1	2	1	1	2
								Frontal	2	2	2	2	1	1	2	1	1	2
2	3	1	2	1	3	2	2	**Icing**										
								In-Flight	1	1	1	1	1	2	2	2	1	2
								Ground	2	2	2	2	2	2	1	2	1	2
								Carburetor	3	3	3	2	1	2	1	3	2	2
3	3	3	3	3	3	3	3	**Wake Vortex**	1	1	1	1	1	1	2	1	1	2
3	3	3	3	3	2*	3	3	**Volcanic Ash**	2	2	2	3	1	1	1	1	1	2
3	3	3	3	2	3	3	3	**Runway Contam.**	2	3	1	2	1	2	1	1	1	2

1	Significant Contributer to Accidents
2	Moderate Contributer to Accidents
3	Minimal Contributer to Accidents

1	Minimal or No Current Capability
2	Current Capability/Systems Partially Capable
3	Current Capability/Systems Reasonably Adequate
	Not Applicable

Current R&D Assessment Matrix

(Weather)

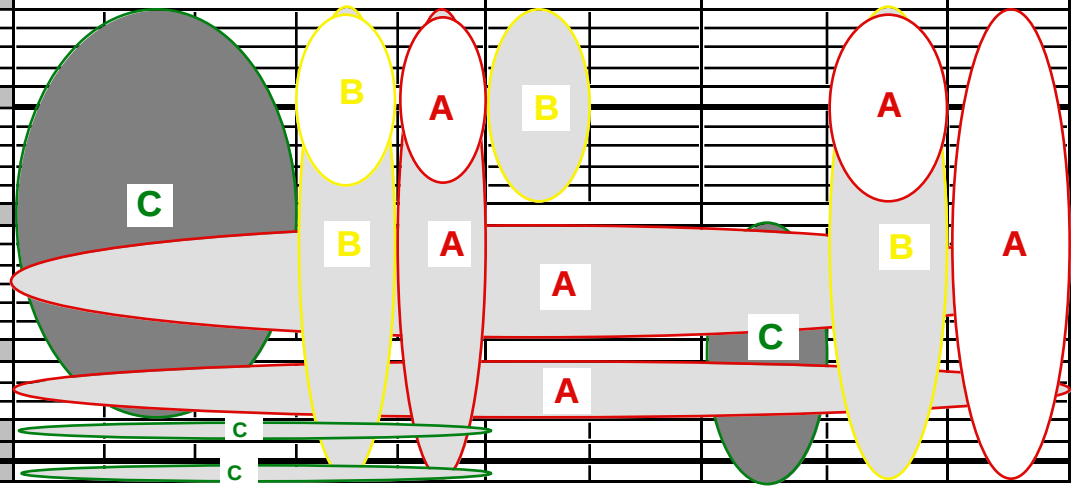
Accident Rate Data (approx)									Strategic Weather Information					Tactical Weather Information and Aircraft Systems		Weather Operations		
G/A		Commuter		Transport		Rotorcraft		*Current Weather R&D Assessment*	Sensing	Collection	Modeling and Forecasting	Product Generation	Data Dissem-ination	Sensors/ Systems	Weather Tolerant Aircraft Design	Simulation and Hazard Character-ization	Crew/Dispatch /ATC Hazard Monitoring, Display, and Decision Support	Crew/Dispatch /ATC Training
Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal											
1	1	1	1	1	2	1	1	**Ceiling & Visibility**										
								Fog/Haze	2	1	1	2	2	2		1	1	1
								Precipitation	3	2	1	2	2	2		1	1	1
								Clouds	2	2	2	2	2	2		1	1	1
								Night Ops						2				
3	2	2	2	2	3	2	2	**Convection and Winds**										
								Thunderstorms	3	2	2	2	2	1	1	2	1	1
								Hail	2	2	2	1	2	2	1	2	1	1
								Heavy Rain	3	2	2	2	2	1	1	1	1	1
2	1	2	2				1	Winds	1	1	2	2	2	2	1	1	1	1
		2		2				Wind Shear	3	2	1	1	2	2	1	1	1	1
3	3	3	3	3	1	3	3	**Turbulence**										
								Convection	1	2	2	2	2	1	1	2	1	1
								Terrain Induced	3	2	2	2	2	1	1	2	1	1
								Jet Stream	1	2	2	2	2	1	1	2	1	1
								Tropopause	1	2	2	2	2	1	1	2	1	1
								Gravity Waves	1	2	1	1	2	1	1	2	1	1
								Frontal	1	2	2	1	2	1	1	2	1	1
2	3	1	2	1	3	2	2	**Icing**										
								In-Flight	2	2	2	2	1	2	2	2	1	1
								Ground	2	2	2	2	1	2	1	2	1	1
								Carburetor	1	2	2	1	1	1	1	1	1	1
3	3	3	3	3	3	3	3	**Wake Vortex**	2	1	2	2	2	1	1	1	2	1
3	3	3	3	3	2*	3	3	**Volcanic Ash**	1	1	2	1	1	1	1	1	1	1
3	3	3	3	2	3	3	3	**Runway Contam.**	2	2	2	1	1	2	1	2	1	1

1 Significant Contributer to Accidents
2 Moderate Contributer to Accidents
3 Minimal Contributer to Accidents

1 Minimal Or No R&D Efforts Underway or Funded
2 Moderate R&D Efforts Underway or Funded
3 Significant R&D Efforts Underway or Funded
Not Applicable

5-Year Investment Matrix
(Weather)

Accident Rate Data (approx)									Strategic Weather Information					Tactical Weather Information and Aircraft Systems		Weather Operations		
G/A		Commuter		Transport		Rotorcraft		*5 Year Weather Project Areas*	Sensing	Collection	Modeling and Forecasting	Product Generation	Data Dissem-ination	Sensors/ Systems	Weather Tolerant Aircraft Design	Simulation and Hazard Character-ization	Crew/Dispatch /ATC Hazard Monitoring, Display, and Decision Support	Crew/Dispatch /ATC Training
Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal											
1	1	1	1	1	2	1	1	**Ceiling & Visibility**										
								Fog/Haze										
								Precipitation										
								Clouds										
								Night Ops										
3	2	2	2	2	3	2	2	**Convection and Winds**										
								Thunderstorms										
								Hail										
								Heavy Rain										
2	1	2	2				1	Winds										
		2		2				Wind Shear										
3	3	3	3	3	1	3	3	**Turbulence**										
								Convection										
								Terrain Induced										
								Jet Stream										
								Tropopause										
								Gravity Waves										
								Frontal										
2	3	1	2	1	3	2	2	**Icing**										
								In-Flight										
								Ground										
								Carburetor										
3	3	3	3	3	3	3	3	**Wake Vortex**										
3	3	3	3	3	2*	3	3	**Volcanic Ash**										
3	3	3	3	2	3	3	3	**Runway Contam.**										



1 Significant Contributer to Accidents
2 Moderate Contributer to Accidents
3 Minimal Contributer to Accidents

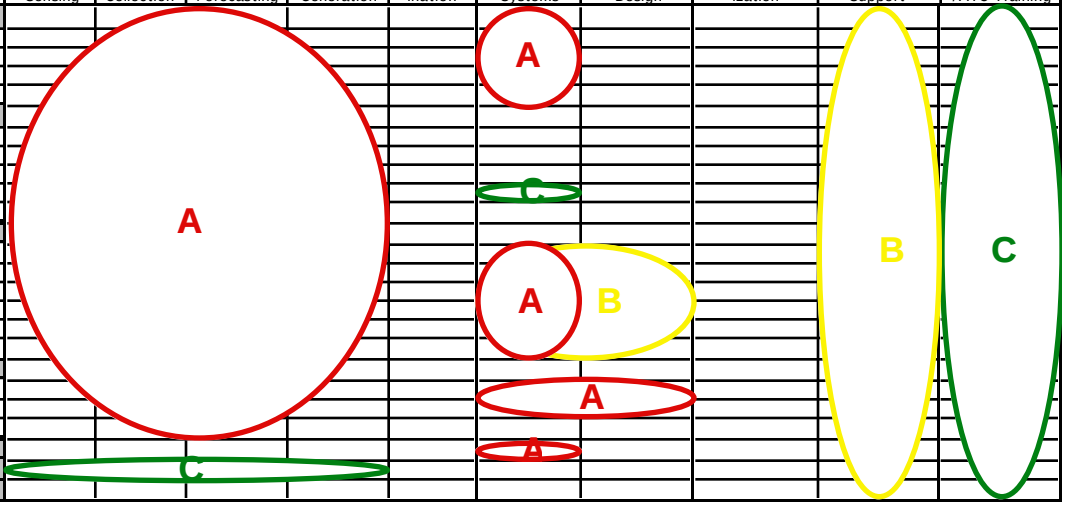
"A" First Priority Investment Areas
"B" Second Priority Investment Areas
"C" Third Priority Investment Areas

GA Prime Focus Investment Area
Transport Prime Focus Investment Area
Both GA and Transport Investment Area

15-Year Investment Matrix

(Weather)

Accident Rate Data (approx)									Strategic Weather Information					Tactical Weather Information and Aircraft Systems		Weather Operations		
G/A		Commuter		Transport		Rotorcraft		*15 Year Weather Project Areas*	Sensing	Collection	Modeling and Forecasting	Product Generation	Data Dissem-ination	Sensors/ Systems	Weather Tolerant Aircraft Design	Simulation and Hazard Character-ization	Crew/Dispatch /ATC Hazard Monitoring, Display, and Decision Support	Crew/Dispatch /ATC Training
Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal	Fatal	Non-Fatal											
1	1	1	1	1	2	1	1	**Ceiling & Visibility**										
								Fog/Haze										
								Precipitation										
								Clouds										
								Night Ops										
3	2	2	2	2	3	2	2	**Convection and Winds**										
								Thunderstorms										
								Hail										
								Heavy Rain										
2	1	2	2				1	Winds										
		2		2				Wind Shear										
3	3	3	3	3	1	3	3	**Turbulence**										
								Convection										
								Terrain Induced										
								Jet Stream										
								Tropopause										
								Gravity Waves										
								Frontal										
2	3	1	2	1	3	2	2	**Icing**										
								In-Flight										
								Ground										
								Carburetor										
3	3	3	3	3	3	3	3	**Wake Vortex**										
3	3	3	3	3	2*	3	3	**Volcanic Ash**										
3	3	3	3	2	3	3	3	**Runway Contam.**										



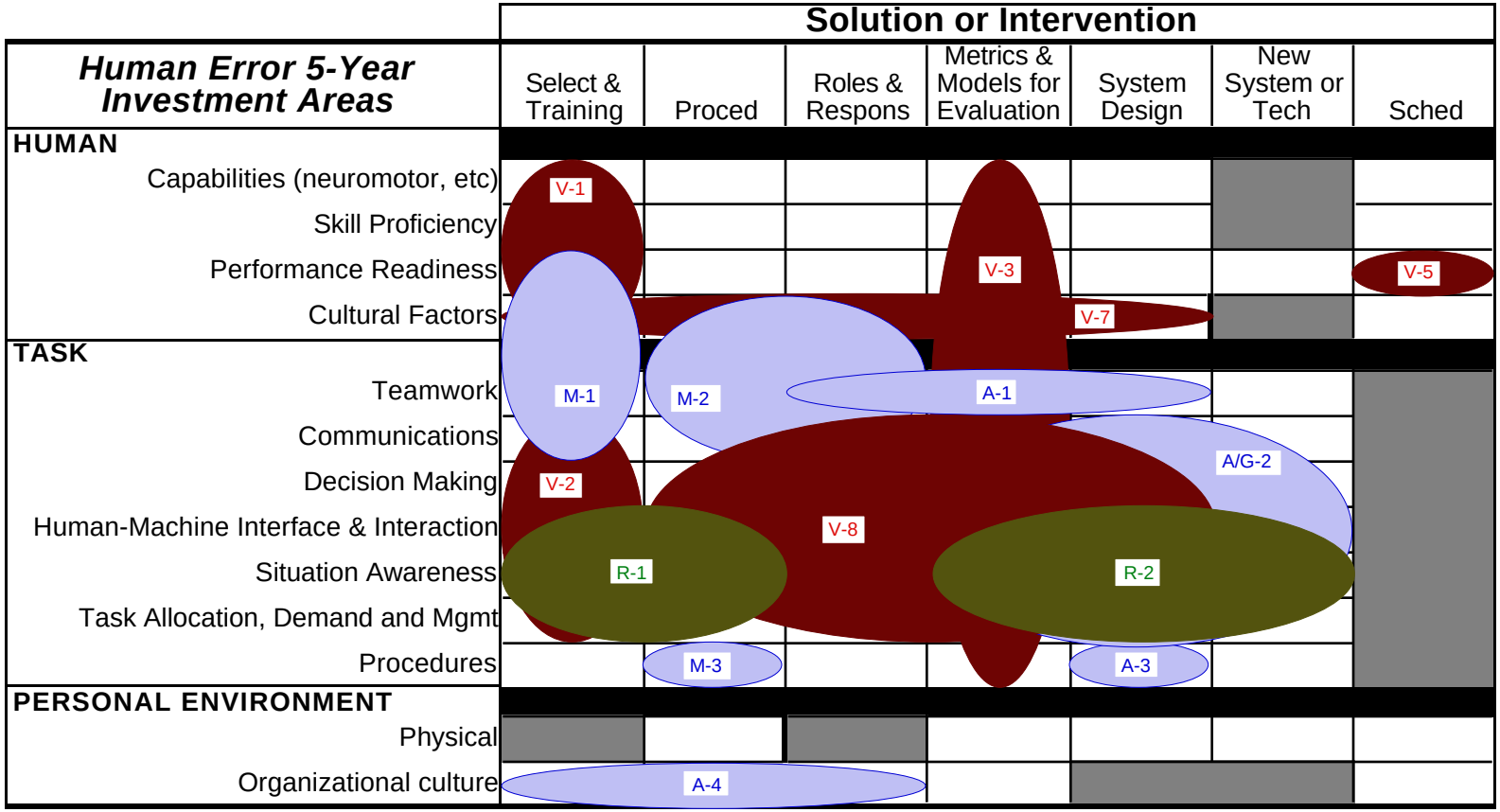
1 Significant Contributer to Accidents
2 Moderate Contributer to Accidents
3 Minimal Contributer to Accidents

"A" First Priority Investment Areas
"B" Second Priority Investment Areas
"C" Third Priority Investment Areas

Investment Area

5-Year Investment Matrix

(Human Error)



A, G, M Airline/GA/Maint

R Rotorcraft

V ALL Vehicles

A-1 Design to support Teamwork
A-3 Procedures Design Methods
A-4 Organizational Culture for Safety
A/G- Flight Deck Design and Integration
M-1 Maintenance Training (augment FAA ongoing pgm)
M-2 Maintenance Teamwork Procedures & Roles/Responsibilities
M-3 Maintenance Task Procedures
R-1/ Rotorcraft-specific Procedures and Training
R-2 Rotorcraft-specific pilot aiding systems

V-1 HUMAN Selection & Training
V-2/2* TASK Selection & Training
V-3 HUMAN/TASK Metrics & Models for Evaluation
V-4 Skill Proficiency
V-5 Fatigue and Circadian Disruption Impacts
V-6 Design to support Performance Readiness
V-7 Cultural Factors
V-8/8* Human/Automation Design Principles and Guidelines

5-Year Investment Matrix

(Flight Critical Systems & Information Integrity)

FCSII 5-Year Investment Areas	**Solution/Intervention Areas**							
Issues	Sensing	On-board Algorithms (e.g. control, health monitoring)	Actuating (incl. Hydraulics and Electric)	Maintenance & Inspection	Materials & Structures	Interface, Comm., & Display	Design, Verification, Certification, Manufacture	CNS/ATM
Airframe	2							
Propulsion								
Systems								
Integration	2							2
Information Integrity								
Air Traffic Control								

Aircraft Control in Adverse

Aging Aircraft Systems

Life Prediction, Modeling, and NDE

Flight Critical System Design, Verification, and Certification Methods

Technology Integration, Validation, and Effective Transition

Health & Usage Monitoring Systems for Rotorcraft & Aircraft

Design/Assessment of Data Link

NAS Tools for Safety & Security

1	High Need
2	Medium Need
3	Low or No Need
	Not Applicable

Potential 5-Year Investment:

5.1 Aircraft Control in Adverse Conditions

5.2 Life Prediction, Modeling, and NDE

5.3 Aging Aircraft Systems

5.4 Flight Critical System Design, Verification, and Certification Methods

5.5 Technology Integration, Validation, and Effective Transition

5.6 Design & Safety/Risk Assessment of Data Link Technologies

5.7 NAS Tools for Safety & Security

5.8 Health & Usage Monitoring Systems for Rotorcraft & Aircraft

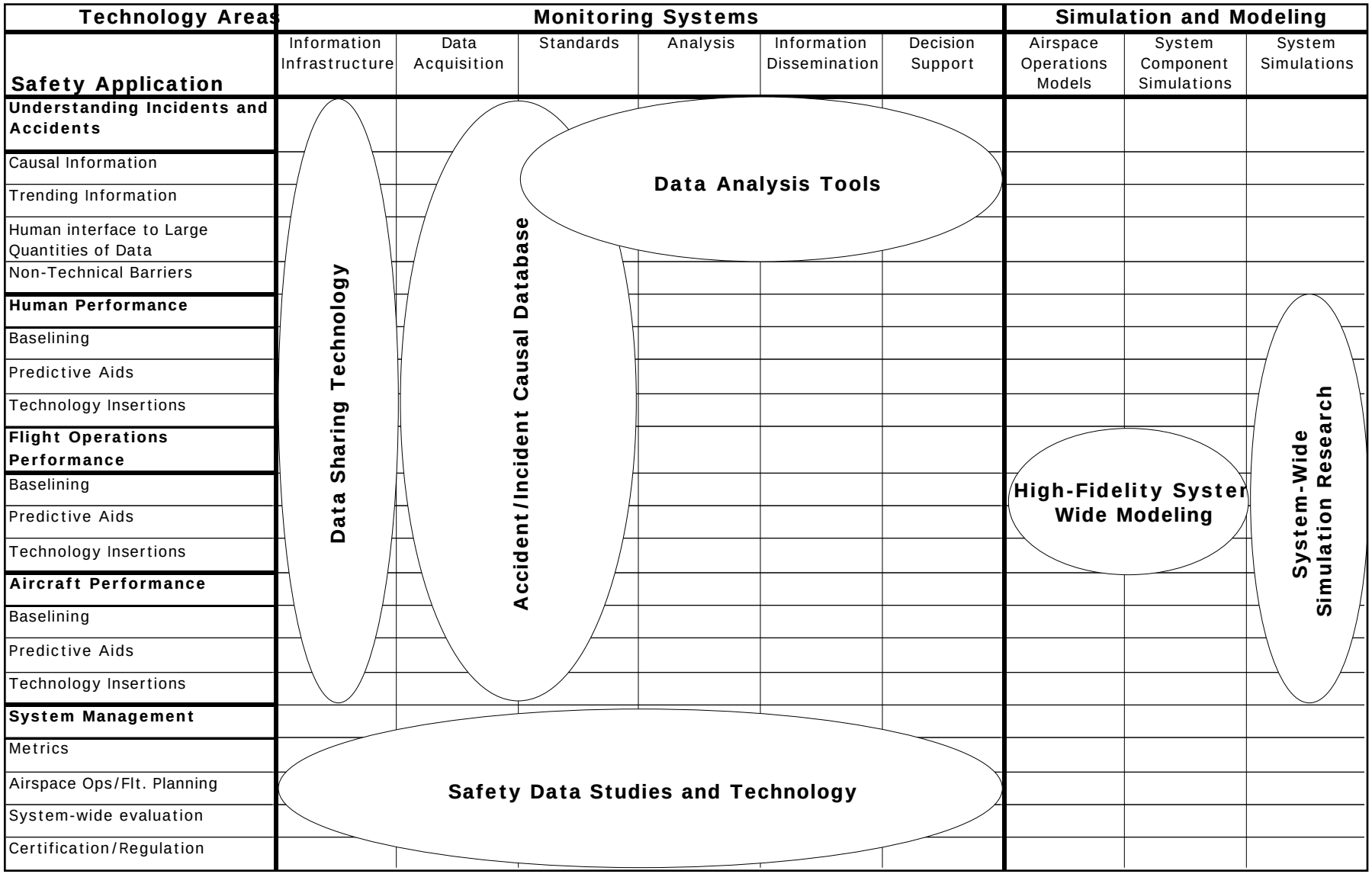
5 Year Investment Matrix

(Accident Mitigation)

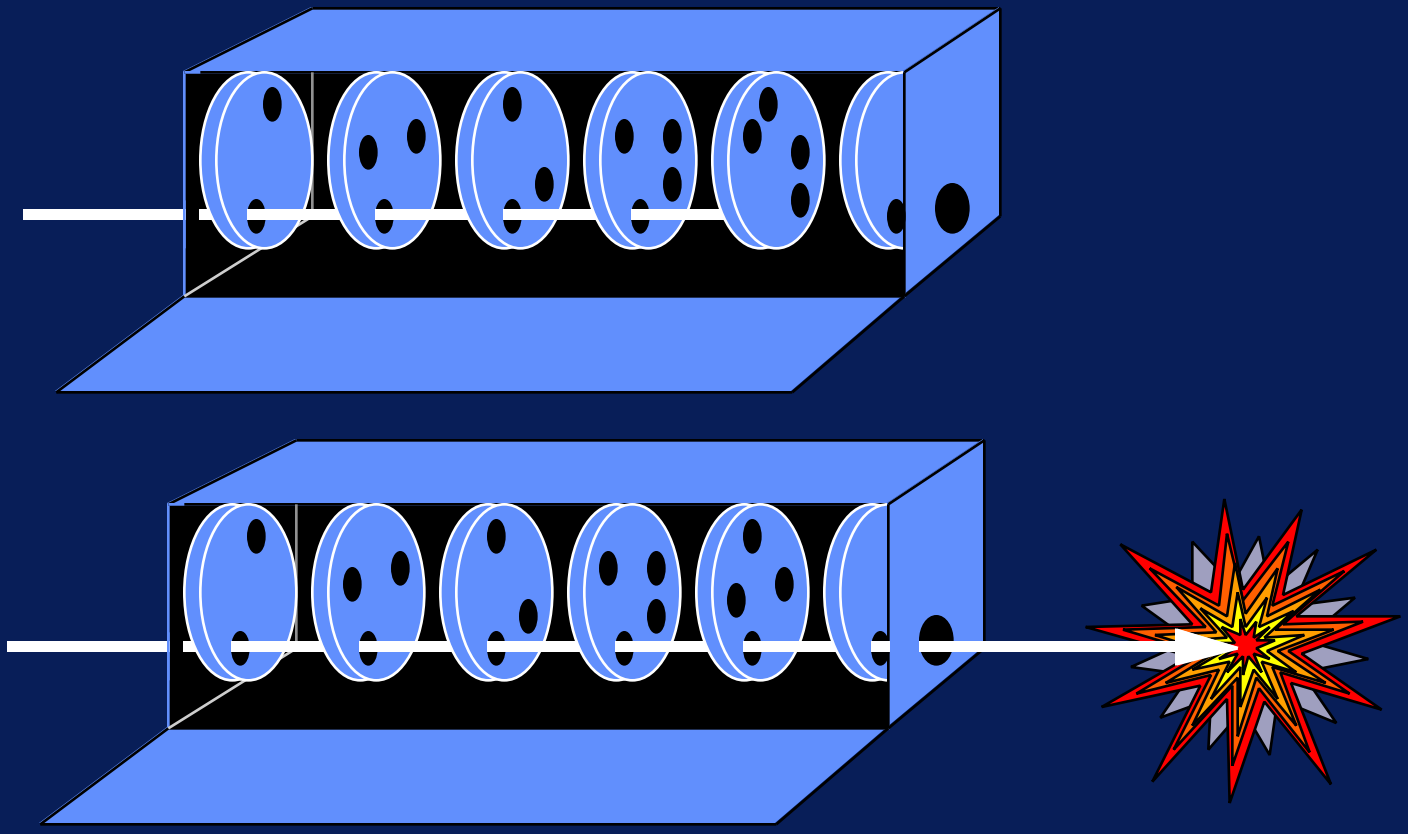
Fatal Accident Statistics Fatal But Survivable Accidents	Solutions /Approaches								
	Fatalities & Serious Injuries Related to	Alternate Ox System/Prot. Devices for Contaminants/	Detection/ Suppression Systems	Fire Safe Fuel / Crash Res. Fuel Systems	Procedures/ Training	SystemDesign/ Standards /Criteria	Analysis/ Modeling	Structural Concepts	Adv. Seats/ Restraint Sys.
See Statistics Charts	CRASH (Impact)					Systems Approach to Crashworthiness PRIORITY 2			
	FIRE		Fire Prevention PRIORITY 1						
	EVACUATION				Systems Approach to Evacuation PRIORITY 3				
	OCCUPANT PROTECTION (Maintaining Physiological Stability)	Occupant Prot. PRIORITY 4							

Five-Year Investment Matrix

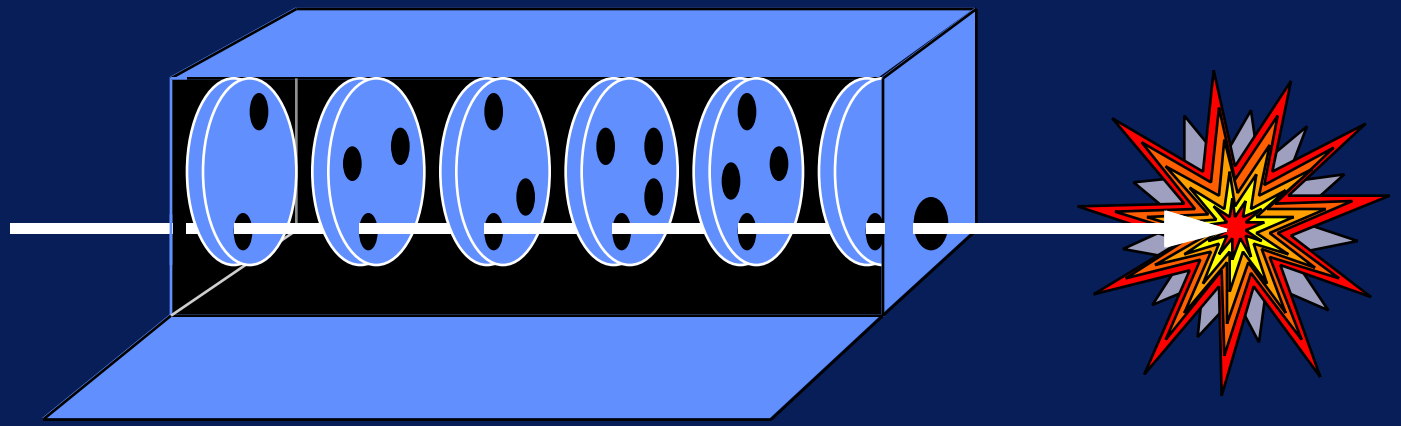
(Aviation System Modeling and Monitoring)



Accidents Result From a Combination of Events

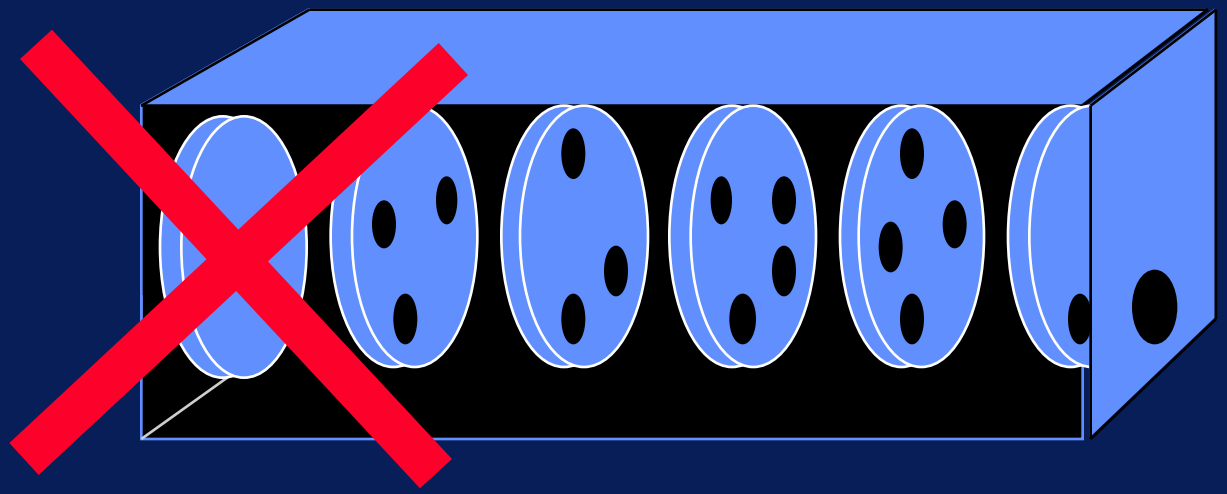


Challenge: Develop Solutions to Eliminate Entire Categories of Accidents, not Single Cases



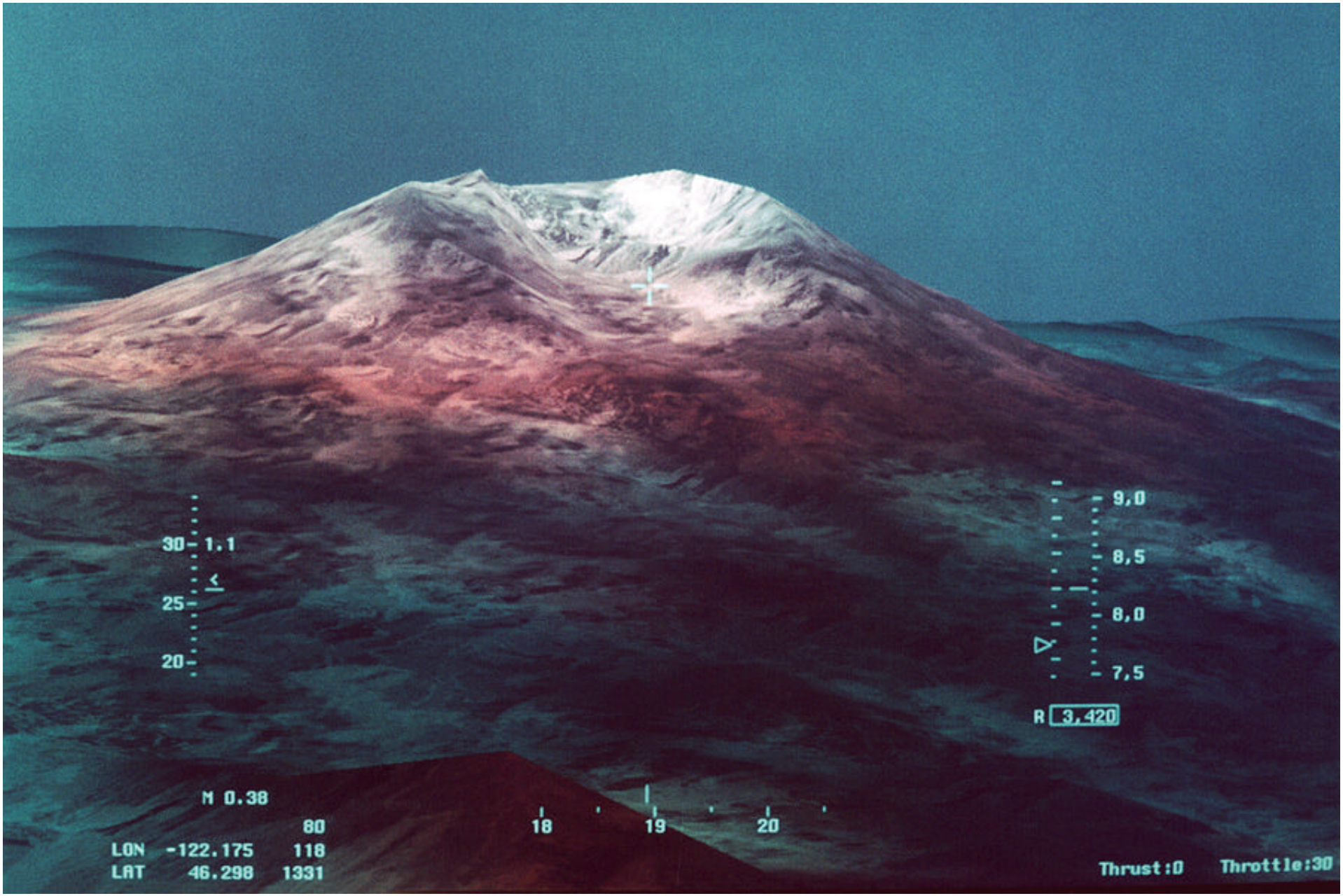
- Accident/Incident Analysis
- Safety Metrics
- System-Wide Monitoring and Modeling

Strategy #1: "Attack the hole on the left"- Prevent the Initial Event

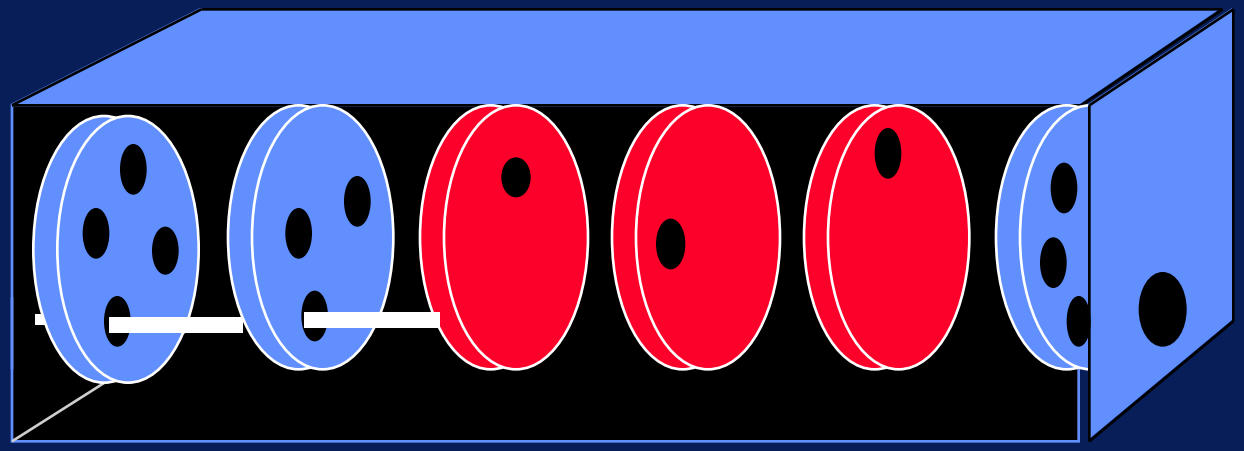


Example Solutions

- "Virtual VMC" Displays for Night/Low Visibility Conditions
- World-Wide Digital Weather Information for Graphical Cockpit Displays


30
1.1
25
20
9,0
8,5
8,0
7,5
R 3,420
M 0.38
80
18
19
20
LON -122.175 118
LAT 46.298 1331
Thrust:0
Throttle:30

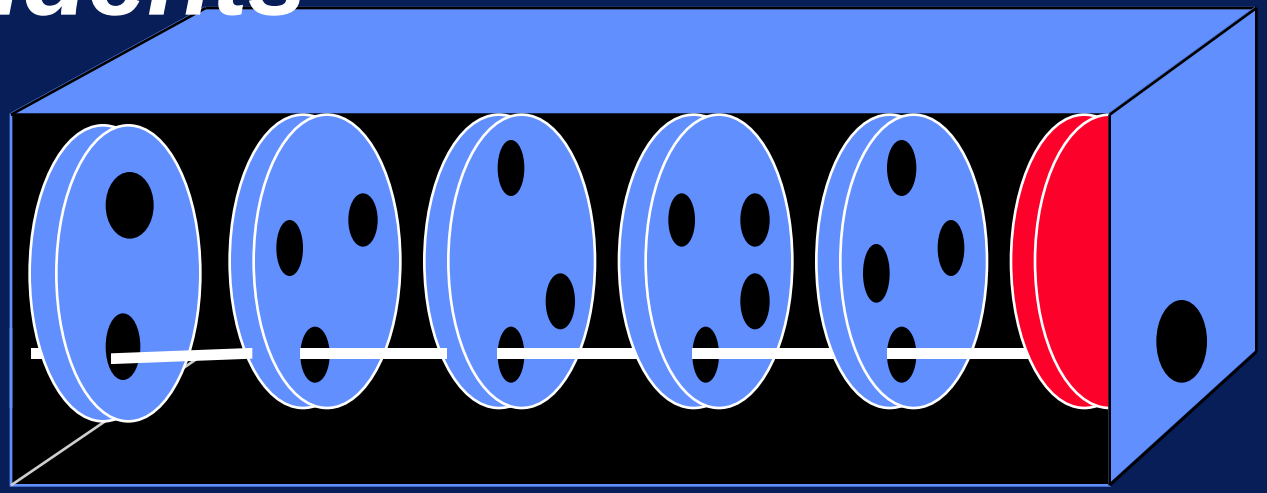
Strategy #2: "Design/Operate with Fewer and Smaller Holes"



Example Solutions

- Error-Proof Flight Deck Designs
- Guaranteed Flight Critical Information Integrity

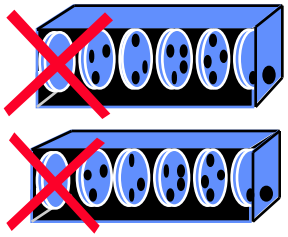
Strategy #3: "Add a solid disk to block failures from becoming accidents"



Example Solutions

- Re-Configurable Flight Controls
- Engine Failure Containment
- Crashworthy Structural and Fuel System Designs

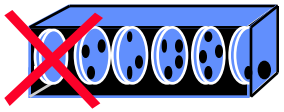
Early Starts



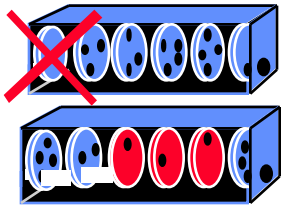
Disseminate Current Weather Products

Identify Accident Precursors

- **Studies**
- **Analysis Tools & Techniques**
- **Tools for Airline FOQA Programs**



Advanced General Aviation Technology Experiment (AGATE) Results



Helicopter Health & Usage Monitoring

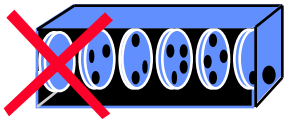
Human Error Metrics - Design & Procedures

Improved Training - Weather, FMS, Maintenance

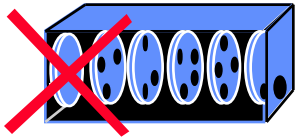
Aging Aircraft & Systems NDE Tools & Methods

Integrated Crashworthiness for GA Aircraft

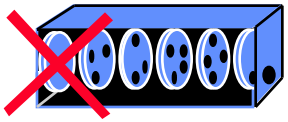
The Future



"Virtual VMC" Displays for Night/IMC Conditions



World-Wide Strategic Separation from Hazardous Weather, Traffic, and Terrain



Aircraft and Aviation System-Wide Health Monitoring and Failure Prediction

Error-Proof Flight Decks

Measurable Training and Operator Proficiency

Guaranteed Flight Critical Information Integrity

Damage Tolerant Aircraft and Control Systems

Crash-Survivable Aircraft Designs

Timeline to Date

- ASIST Start: 2/97
- ASIST Report: 4/97
- Lead Center Selection: 5/97
- Budget sources identification: 6/97
- Office structure approved: 7/97
- Budget allocations: 7/97
- Program management personnel assignments: 8/97
- Industry Brief: 8/97

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Desired Program Attributes

- **Proper technical breadth/focus & direction to achieve 10x goal**
  - Understand aviation problems, technologies, system integration
  - Technically aggressive (no nibbling at the edges)
  - Goal-oriented, data-driven, metrics-monitored
- **Achieves critical buy-in from aviation community**
  - Other gov't agencies and required breadth of industry/operators/public
  - Operationally realistic & implementable
- **Assures complete path from technology development to test to certification**
- **Effectively manage organization and communication challenges in a multi-Center, multi-agency, multi-industry program**
  - Joint partnerships wherever possible
  - Efficiently/professionally/publicly run
- **Fun and rewarding to work**

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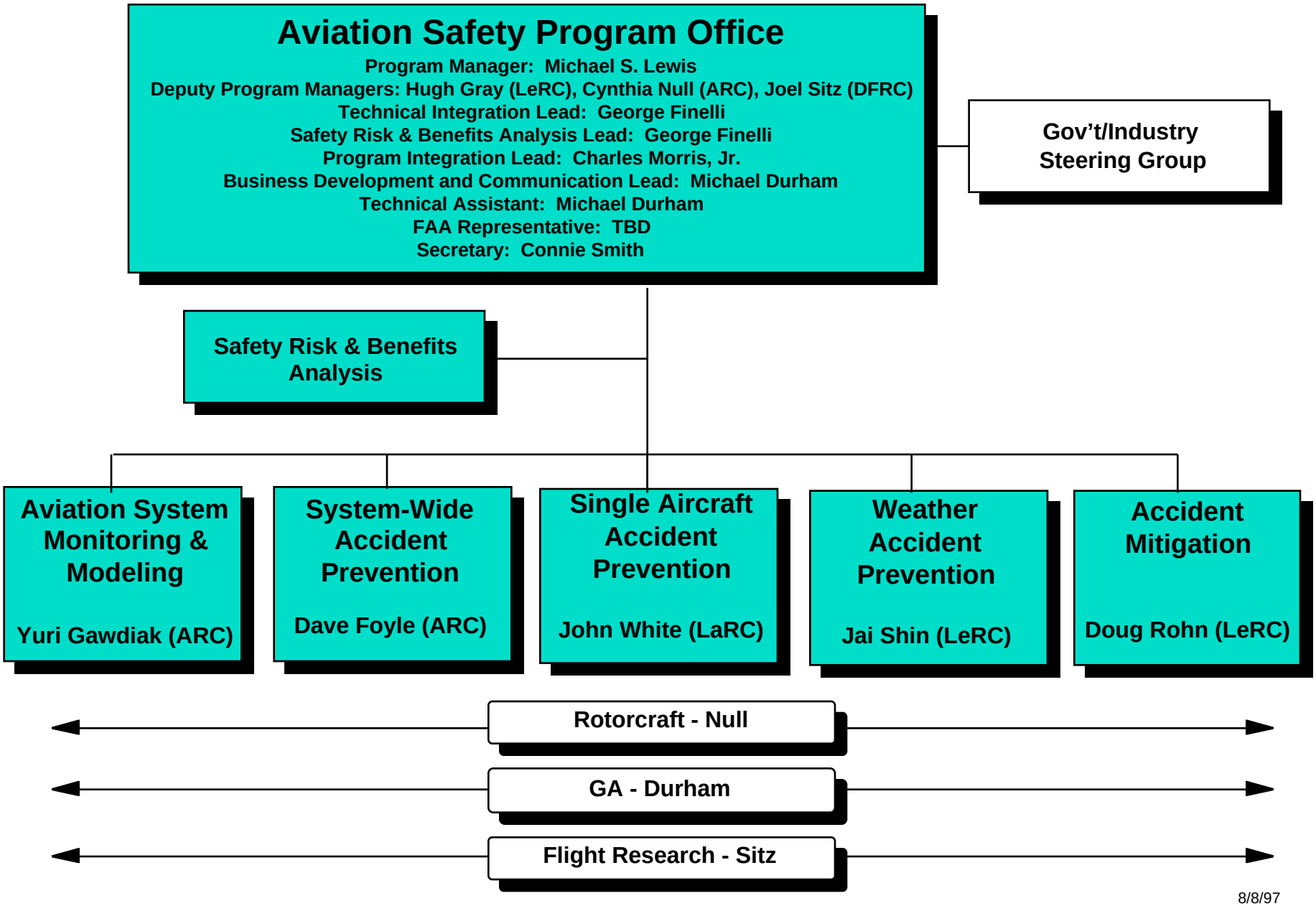
Program Organization



8/8/97

Points of Contact (ASPO)

AVIATION SAFETY PROGRAM OFFICE

NAME	EMAIL	TELEPHONE	FAX
Michael H. Durham	m.h.durham@larc.nasa.gov	757-864-9100	757-864-2166
George B. Finelli	g.b.finelli@larc.nasa.gov	757-864-9100	757-864-2166
Dave Foyle	dfoyle@mail.arc.nasa.gov	650-604-3053	
Yuri O. Gawdiak	ygawdiak@mail.arc.nasa.gov	650-604-4765	
Hugh R. Gray	hugh.r.gray@lerc.nasa.gov	216-433-3230	216-433-6624
Michael S. Lewis	m.s.lewis@larc.nasa.gov	757-864-9100	757-864-2166
Charles Morris	cmorris@hq.nasa.gov	757-864-9100	757-864-2166
Cynthia H. Null	cnull@mail.arc.nasa.gov	650-604-1260	650-604-6990
Douglas A. Rohn	douglas.a.rohn@lerc.nasa.gov	216-433-3325	216-977-7051
Jaiwon Shin	jaiwon.shin@lerc.nasa.gov	216-433-8714	216-433-2182
Joel Sitz	joel.sitz@dfrc.nasa.gov	805-258-3666	805-258-2134
Connie A. Smith	c.a.smith@larc.nasa.gov	757-864-9100	757-864-2166
John J. White, II	j.j.white@larc.nasa.gov	757-864-3849	757-864-2166

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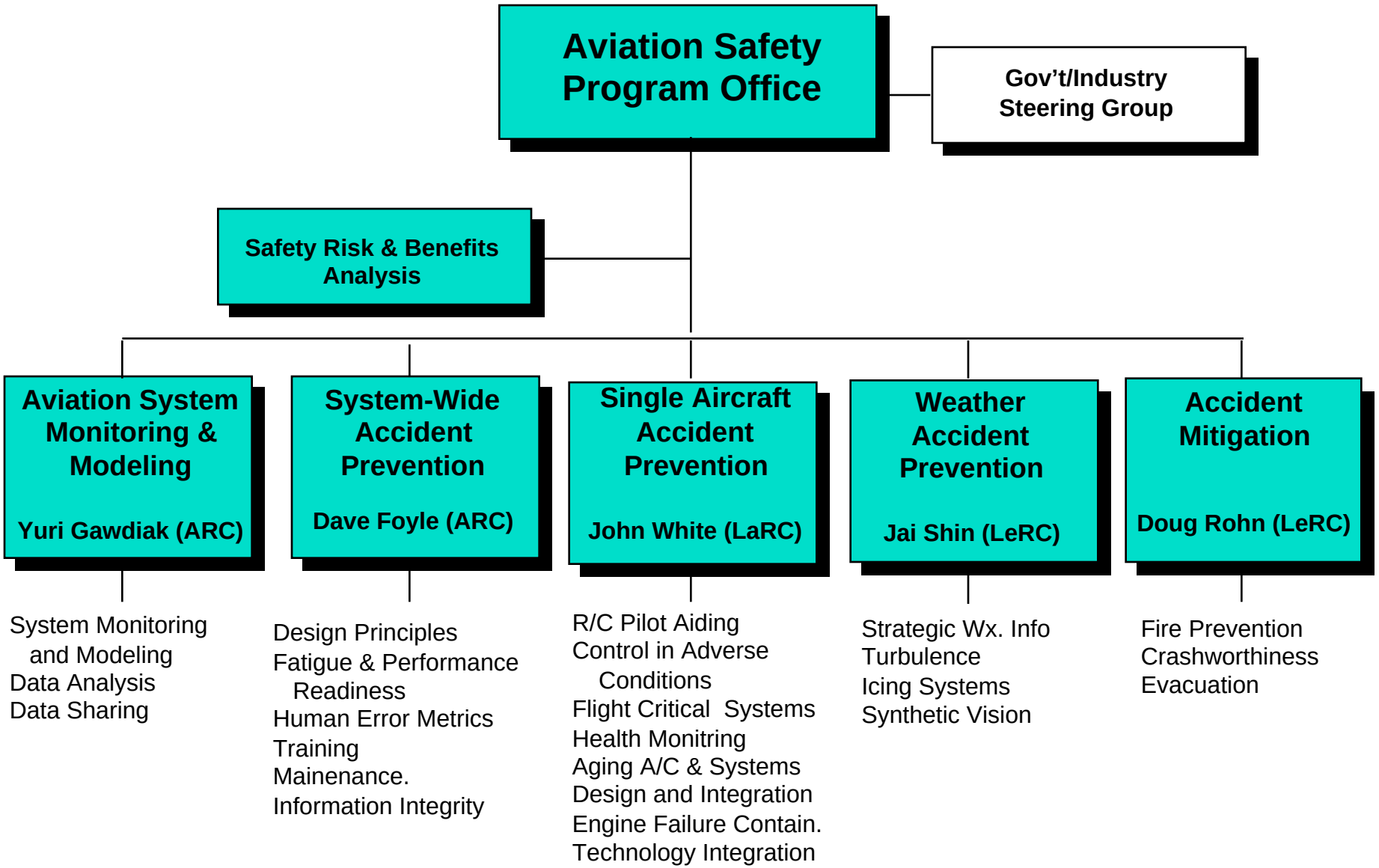
From ASIST Elements to ASP Groups

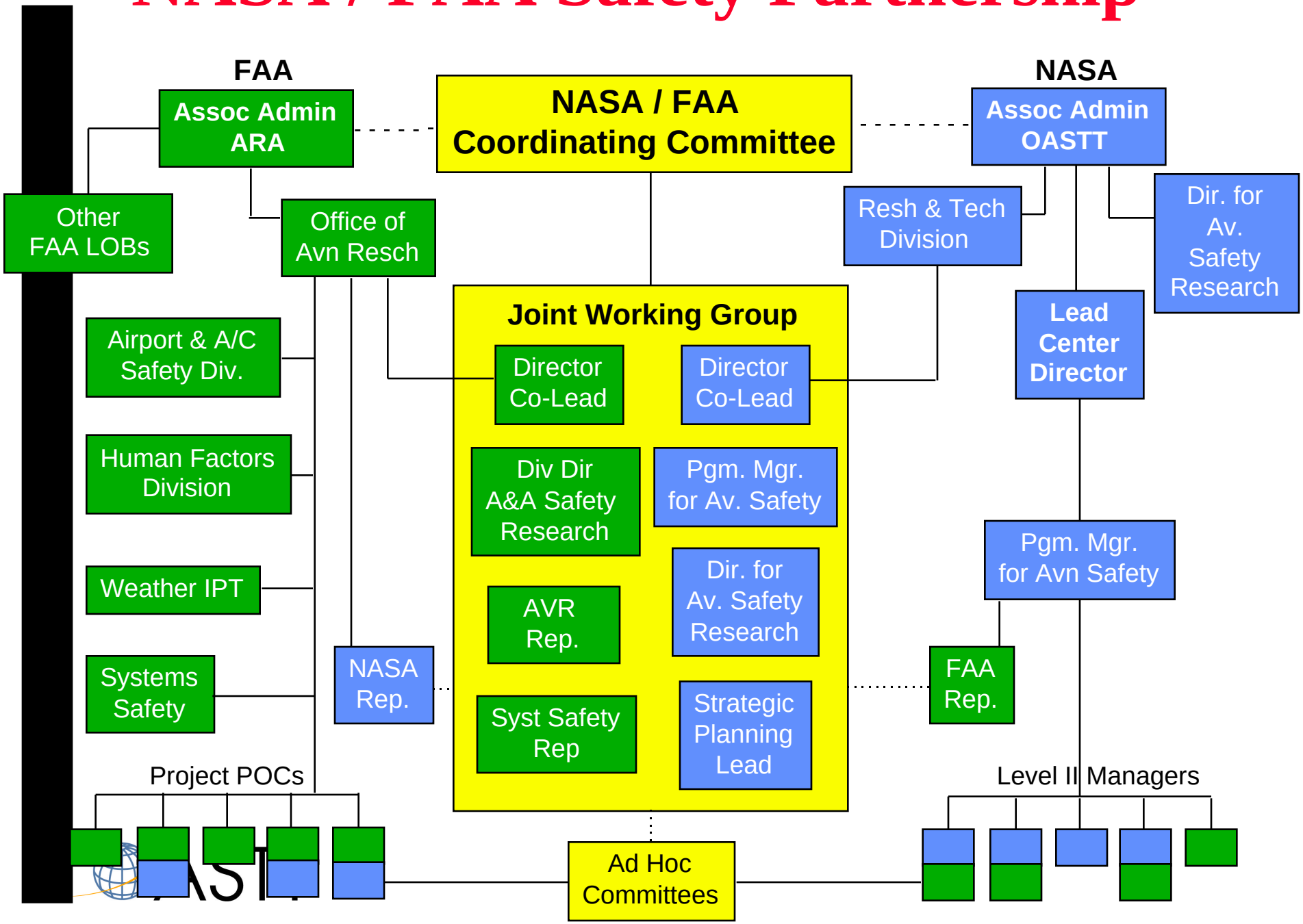
ASIST Elements	ASP Groups
Aircraft Control in Adverse Conditions	Adverse Conditions
Fault & Damage Tolerance	
Advanced Containment Concepts for Engine Failure	Engine Failure
Life Prediction, Modeling, & NDE	Aging Systems
Aging Aircraft Systems	
Design, Verification, & Cert. Methods for Flight Critical Systems	Flight Critical Systems
Design Tech. for High-Integrity Complex Digital Sys.	
FCSII Technology Integration, Validation, & Effective Transition	Tech Integration
Design & Safety/Risk Assessment of Data Link Tech.	Info Integrity
NAS Tools for Safety & Security	
R/C Health & Usage Monitoring Systems	Health Monitoring
Health Monitoring & Fault Diagnostics	
Human/Task Metrics & Models for Evaluation	HEC Metrics
Human/ Automation Design Principles and Guidelines	Design Principles
Cultural Factors	
Skill Proficiency	
Design to Support Performance Readiness	
Procedures Desgin Methods	
Design to Support Teamwork	
Task Selection and Training	Training
Human Selection & Training	
Rotocraft-specific Selection and Training	
Skill Proficiency	
Flight Deck Design and Integration	Design & Integration
Cultural Factors	
Skill Proficiency	
Design to Support Performance Readiness	
Procedures Desgin Methods	
Design to Support Teamwork	

ASIST Elements	ASP Groups
Maintenance Teamwork Procedures & Roles/Resp	Maintenance
Maintenance Training	
Maintenance Task Procedures	
Fatigue and Circadian Disruption Impacts	Fatigue and Performance Read
Human/Design Principles & guidelines	Rotorcraft Pilot Aiding
Rotorcraft-specific Pilot Aiding Systems	
Digital Weather Product Dissemination	Strategic Weather Information
Crew/Dispatch/Wx Monitoring Pres. & Decision Making	
Advanced Weather Products	
Advanced Aviation Meteorology	
Tactical Weather Sensors/ Systems	
Advanced Vision and Sensor Technology	Synthetic Vision
Icing Hazard Solutions	Weather Icing
Turbulence Hazard Solutions	Turbulence
Data Analysis Tools	Data Analysis
Accident/Incident Causal Database	
Safety Data Studies & Tech.	
Data Sharing Technology	Data Sharing
Next-Gen. Communication Tech.	
Aviation System Safety Mon	Monitoring
Strategic Sys. Mgmt. Aids	
Intra-Organizational & Paticipatory Safety Info. Sys.	
High-fidelity Sys-wide Modeling	
Fire Prevention	Fire Prevention
Systems Approach to Crashworthiness	Systems Approach to Crashwo
Systems Approach to Evacuation	Systems Approach to Evacuati

Program Organization



NASA / FAA Safety Partnership



ASP/ASIST
Planning Points of Contact

Aviation Safety Program Investment Area	ASIST Title(s)	NASA Planning POC			FAA Planning POC		
Adverse Conditions	Aircraft Control in Adverse Conditions Fault & Damage Tolerance	Carrie Walker c.k.walker@larc.nasa.gov	LaRC	757-864-6031	Bill Emerling	AAR-400	609-485-4009
Engine Failure	Advanced Containment Concepts for Engine Failure	Hugh Gray hugh.r.gray@lerc.nasa.gov	LeRC	216-433-3230	Bill Emerling	AAR-400	609-485-4009
Aging Aircraft/Systems	Life Prediction, Modeling, & NDE Aging Aircraft Systems	Bill Cazier f.w.cazier@larc.nasa.gov	LaRC	757-864-2860	Mike Basehore	AAR-400	609-485-6342
Flight Critical Systems	Design, Verification, & Cert Methods for Flight Critical Systems Design Techniques for High-Integrity Complex Digital Systems	Carrie Walker c.k.walker@larc.nasa.gov	LaRC	757-864-6031	Bill Emerling	AAR-400	609-485-4009
Tech Integration	FCSII Tech Integration, Validation, & Effective Transition	Joel Sitz joel.sitz@dfrc.nasa.gov	DFRC	805-258-3666	Mike Basehore	AAR-400	609-485-6342
Info Integrity	Design & Safety/Risk Assessment of Data Link Technologies NAS Tools for Safety & Security	Paul Ma pma@mail.arc.nasa.gov	ARC	415-604-3586	Dallas Bighoff	ASY-100	202-493-4249
Health Monitoring	R/C Health & Usage Monitoring Systems Health Monitoring & Fault Diagnostics	Carrie Walker c.k.walker@larc.nasa.gov	LaRC	757-864-6031	Bill Emerling	AAR-400	609-485-4009
Human Error Model/Metrics	Human/Task Metrics & Models for Evaluation	Lee Stone lstone@mail.arc.nasa.gov	ARC	615-404-3240	Mike McAnulty	ACT-510	609-485-4751
Design Principles	Human/ Automation Design Principles and Guidelines Cultural Factors Skill Proficiency Design to Support Performance Readiness Procedures Desgin Methods Design to Support Teamwork	Mike Shafto mshafto@mail.arc.nasa.gov	ARC	415-604-6170	Kathy Abbott	AIR	757-864-2018
Training	Task Selection and Training Human Selection & Training Rotocraft-specific Selection and Training Skill Proficiency	Mary Conners mconnors@mail.arc.nasa.gov	ARC	415-604-6114	Eleana Edens	AAR-100	202-267-7219
Design & Integration	Flight Deck Design and Integration Cultural Factors Skill Proficiency Design to Support Performance Readiness Procedures Desgin Methods Design to Support Teamwork	Carrie Walker c.k.walker@larc.nasa.gov	LaRC	757-864-6031	Tom McCloy	AAR-100	202-267-7219

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ASP/ASIST
Planning Points of Contact (continued)

Aviation Safety Program Investment Area	ASIST Title(s)	NASA Planning POC			FAA Planning POC		
Maintenance	Maintenance Teamwork Procedures & Roles/Responsibilities Maintenance Training Maintenance Task Procedures	Mary Conners mconnors@mail.arc.nasa.gov	ARC	415-604-6114	Joan Watson	AAM-240	202-366-6915
Fatigue and Performance Readiness	Fatigue and Circadian Disruption Impacts	Lee Stone lstone@mail.arc.nasa.gov	ARC	615-404-3240	Ron Simmons	ABZ-100	202-267-7058
Rotorcraft Pilot Aiding	Human/Design Principles & guidelines Rotorcraft-specific Pilot Aiding Systems	Bill Hindson	ARC	415-604-1106			
Strategic Weather Info	Digital Weather Product Dissemination Crew/Dispatch/Wx Monitoring Presentation & Decision Making Advanced Weather Products Advanced Aviation Meteorology Tactical Weather Sensors/ Systems	John White j.j.white@larc.nasa.gov	LaRC	757-864-3849	Ken Leonard	AUA-400	202-267-7397
Synthetic Vision	Advanced Vision and Sensor Technology	Carrie Walker c.k.walker@larc.nasa.gov	LaRC	757-864-6031	Ken Leonard	AUA-400	202-267-7397
Weather Icing	Icing Hazard Solutions	Jai Won Shin	LeRC	216-433-8714	Charlie Masters	AAR-400	609-485-6663
Turbulence	Turbulence Hazard Solutions	John White j.j.white@larc.nasa.gov	LaRC	757-864-3849	Ken Leonard	AUA-400	202-267-7397
Data Analysis	Data Analysis Tools Accident/Incident Causal Database Safety Data Studies & Tech.	Mary Conners mconnors@mail.arc.nasa.gov	ARC	415-604-6114	Carolyn Edwards	ASY-200	202-267-9168
Data Sharing	Data Sharing Technology Next-Gen. Communication Tech.	Yuri Gawdiak ygawdiak@mail.arc.nasa.gov	ARC	415-604-4765	Dallas Bighoff	ASY-100	202-493-4249
Monitoring	Aviation System Safety Mon Strategic Sys. Mgmt. Aids Intra-Organizational & Paticipatory Safety Info. Sys. High-fidelity Sys-wide Modeling	Mary Conners mconnors@mail.arc.nasa.gov	ARC	415-604-6114	Carolyn Edwards	ASY-200	202-267-9168
Fire Prevention	Fire Prevention	Bill Cazier f.w.cazier@larc.nasa.gov	LaRC	757-864-2860	Dick Hill	AAR-400	609-485-5997
Systems Approach to Crashworthiness	Systems Approach to Crashworthiness	Bill Cazier f.w.cazier@larc.nasa.gov	LaRC	757-864-2860	Gary Frings	AAR-400	609-485-5781

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Communications

- Program Management Personnel
- Technical Planning NASA/FAA Leads
- Internet address
  - http://www.nasa.gov
  - Then go to “Aeronautics”
  - Then go to “Current Events” to find the “ASIST” site
- Video of Briefing

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Near Term Timeline

- Industry Brief 8/97
- Detailed Planning Workshops 9/97-12/97
- Early Activities Initiated 10/97 - 12/97
- Prepare/Issue NASA Research Announcement (or equivalent) - 11/97-2/98
- Proposals Due - 1/98 - 3/98
- Proposals Reviewed - 2/98 - 5/98
- New Starts Initiated 4/98 - 10/98

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Initial Workshop Subjects

- Data Analysis/Data Monitoring
  Data Sharing
- Health Monitoring
- Strategic Weather Information
- Aging Aircraft/Systems
- Fire Prevention
- Crashworthiness
- Synthetic Vision
- Rotorcraft Pilot Aiding
- Training
- Control in Adverse Conditions
- Information Integrity
- Flight Critical Systems
- Human Error

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Project Name/WBS

Overall Potential Accident Rate Impact

Goals/Objectives

R&D Strategy/Approach

Partnership Strategy/Approach

Product Description

Product Implementation Strategy/Plan

Development/Implementation Risk Assessment

Cost/Benefit Assessment

Accident Rate Projection Analysis

Schedule/Milestones

	98	99	00	01	02	03-07
NASA						
FAA						
DoD						
Industry						
University						
International						

Milestone Descriptions and Completion Criteria

Budget

	98	99	00	01	02	03-07
NASA						
Net						
PS						
R&PM						
FAA, DoD, Industry, University, & nternational						

Workforce

	98	99	00	01	02	03-07
NASA						
CS						
SSC						
FAA, DoD, Industry, University, & nternational						

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Workforce Skills Required

Budget Notes

- Baseline $500 M over five years allocated (FY98-FY02)
- Expect equivalent amount in next five years (FY03-FY07) to reach 10-year goal
- Budget $ are “FULL COST”
  - ~1/4 = civil service salaries
  - ~1/4 = program support
  - ~1/2 = “spendable” for in-house and contracted Research and Development

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Program Approach

- NASA will not pay for all of anything
- ASIST activity identified investment areas
- Aviation Safety Program workshops to go from investment areas to specific implementation options
- Aviation Safety Program will then **partner** with industry teams to develop selected options
  - Identify needed and appropriate government and industry roles
  - Identify necessary resource commitments from government/ industry necessary to bring safety product to implementation
  - May form competitive teams

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Program Approach (Cont'd)

- Will not look to work with companies/ individuals that say:
  - " we have good capabilities to work in this area, why don't you pay us to help you"
  - " we have a great safety idea, why don't you pay us to develop it"
  - " this safety idea would have prevented this recent accident, so therefore it should be developed"

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Program Approach

- ***Will*** look to work with companies/individuals that say:
  - " we have done our homework to learn the background of the Aviation Safety Program and aviation accident data" *and*,
  - "we have a safety idea that we can systematically show is applicable to an important group of accident types" *and*,
  - "we are ready to commit significant resources of our own to develop this idea" *and*,
  - "we have partners who agree with our approach and are committing resources of their own", *and*
  - " we face a technical/risk/cost/test/data hurdle that the Aviation Safety Program can help overcome", *and*
  - " we have a plan and the motivation to work together to bring this idea/product/result through to system implementation."

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Business Partnership Strategy

- Will initiate small scale contracted activities in the near term through readily available methods
- Will look to initiate new contracted/cooperative partnered activities following a workshop process:
  - will likely use NRA or some similar approach to efficiently announce multiple project areas and solicit responses
  - Will aim to form partnered teams with cost-sharing participants to jointly develop, test, and **support the implementation** of new technologies and systems.
- Will also use SBIR and STTR programs to target small businesses and universities
- Will likely update NRA solicitation each year

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Program Challenge

- Very large number of very capable people/ organizations interested in working with the program
- Will only be able to fund or work directly with a small % of this group
- Challenge for program:
  - Must continue to keep the support, enthusiasm and respect for the program even after a majority of participants not directly funded.
  - Only way to do this is to be seen by the wide community as:
    - addressing the right technical subjects
    - with an efficient, professional approach
    - making aggressive technical progress
    - so as to provide benefits to the whole community.

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Summary

- **Know about the program**
  - ASIST planning
  - Technical subject areas
  - Program Organization
  - Upcoming schedule
- **Know how to get involved**
  - web site
  - points of contact
  - workshops
  - business strategy
- **Know the program philosophy**
  - focus on the fatal accident rate goal
  - want NASA/FAA/government to be catalyst
  - expectations for partners

ASTT

Summary (Cont'd)

- **Hope that:**
  - You think the program organization/strategy/approach is a good one
  - You're enthusiastic about participating
  - You aggressively start organizing your commitments/ teams/proposals
  - You work with our NASA/FAA team to support, continually assess, and improve our efforts
  - We all work ***together*** to reach the National Goal

ASTT